THURSDAY, AUGUST 25, 1898.

COMPARATIVE ALGEBRA.

A Treatise on Universal Algebra, with Applications. By Alfred North Whitehead, M.A. Vol. I. Pp. xxvi + 586. (Cambridge: at the University Press, 1898.)

THIS work affords a sad illustration of the spirit of lawlessness which has invaded one of our ancient Universities since the time when she rashly began to tamper with her Tripos Regulations. In the good old times two and two were four, and two straight lines in a plane would meet if produced, or, if not, they were parallel; but it would seem that we have changed all that. Here is a large treatise, issued with the approval of the Cambridge authorities, which appears to set every rule and principle of algebra and geometry at defiance. Sometimes ba is the same thing as ab, sometimes it isn't; $a + a$ may be $2a$ or a according to circumstances; straight lines in a plane may be produced to an infinite distance without meeting, yet not be parallel; and the sum of the angles of a triangle appears to be capable of assuming any value that suits the author's convenience. It is a pity that we have not had an opportunity of showing the book to some country rector who graduated with mathematical honours, say, forty years ago; it is easy to imagine his feelings of surprise, bewilderment, possibly of indignation, as he turned over the pages and encountered such a variety of paradoxical statements and unfamiliar formulæ.

Seriously, Mr. Whitehead's work ought to be full of interest, not only to specialists, but to the considerable number of people who, with a fair knowledge of mathematics, have never dreamt of the existence of any algebra save one, or any geometry that is not Euclidean. Its title, perhaps, hardly conveys a precise idea of its contents. It is, in fact, a comparative study of special algebras, exclusive of ordinary algebra, the results of which are taken for granted throughout. Such an undertaking has necessarily involved a very great deal of time and labour; for, in order to carry it out with any degree of success, it is needful, not only to master each separate algebra in detail, but also to adopt some general point of view, so as to avoid the imminent risk of composing, not one work, but a bundle of isolated treatises. Mr. Whitehead has, happily, overcome this difficulty by viewing the different algebras, in the main, in their relation to the general abstract conception of space. Whether this plan can be consistently followed throughout may be open to question: it certainly works very well in this first volume, the keynote of which is Grassmann's Extensive Calculus.

The first special algebra dealt with, however, appeals to a much simpler range of spatial ideas; it is the Algebra of Symbolic Logic, which only requires the conception of closed regions of space which may or may not overlap. This algebra is charmingly simple: it does not involve any arithmetical calculations, or even the use of digits, because both $a + a$ and aa are equivalent to a; and it enjoys a perfect dualism, so that from every proposition (not self-reciprocal) another may be at once inferred. On its value in its logical applications, it would be unwise for a mere mathematician to express an opinion, and the moral philosophers themselves appear to be of different minds on this as on some other questions; but this does not detract from its merits as an algebra of extreme simplicity, combined with symmetry and grace.

The next three Books (III.–V.) deal with positional manifolds, the calculus of extension, and extensive manifolds of three dimensions. In this very important section the reader will find a systematic development of the extensive calculus, with abundance of illustrative applications; so that English mathematicians will no longer have any excuse for ignoring Grassmann's magnificent conceptions. Time alone can show whether, as an instrument of discovery, Grassmann's calculus will prove superior to the ordinary methods; but of its power as a means of expression there can only be one opinion. To see this the reader has only to turn, for example, to the chapters on line geometry (Book V., Chapters i.–iii.), where the properties of null systems, the linear complex, and the invariants of groups of line systems (or, as the author prefers to call them, systems of forces) are proved with extreme directness and simplicity. The *crux* of the calculus is the theory of regressive and inner multiplication, which is discussed in Book IV., Chapters ii., iii.: the reader may be recommended to study these chapters in connection with the applications which follow, especially in Book V., Chapter i., where the formulæ for three dimensions are recapitulated. The idea of intensity is introduced at the outset, and the exposition follows mainly the *Ausdehnungslehre* of 1862: this procedure certainly has its advantages, but makes the extensive calculus appear more closely allied to the barycentric calculus than it naturally is.

Book VII., on the application of the extensive calculus to geometry, is largely concerned with vectors. From Grassmann's point of view a vector, or, as he called it, a "Strecke," is the difference between two extensive magnitudes of equal weight; with an appropriate law of intensity, it may also be regarded, in a sense, as a point at infinity. But there is a certain convenience, when working with vectors, in regarding them as independent elements, after the manner of Hamilton: this method is explained in Chapter iv. of the Book, which contains a number of kinematical and dynamical formulæ. Chapter iii., on curves and surfaces, illustrates very fairly both the strong and the weak points of the calculus.

Book VI. contains a detailed account of the theory of metrics. It is very refreshing to find that this theory is treated by the author in a thoroughly satisfactory way, without any of the sham metaphysics and faulty psychology which so often disfigure it, especially when an attempt is made to expound these abstract ideas to a popular audience. Starting with the purely abstract definition of a positional manifold, it is possible to construct a theory in which there is associated with any two elements of the manifold a numerical quantity called their distance, which may be finite or infinite, real or imaginary, but which only vanishes when the elements coincide. In order to satisfy certain axioms which are analogous to some of the assumptions tacitly or explicitly made in ordinary geometry, and the fundamental theorem of projective geometry that if three points of a row of points are congruent to the three corresponding points

of a homographic range, then the two rows are congruent, it is necessary and sufficient that the distance between two elements a, b is $\kappa \log (abij)$, where κ is a constant and $(abij)$ is the cross-ratio of a, b, i, j, the last two being two fixed elements on the "line" ab, the so-called absolute point-pair of the line. This leads to Cayley's theory of the absolute quadric, and the classification of metrical geometry into the three kinds, elliptic, parabolic, and hyperbolic. The theory of angles between lines or planes, the theory of parallels, and the general definition of perpendicularity follow in due course. In all this there is no hocus-pocus whatever; we have an analytical theory, based upon precise definitions, which is quite independent of any appeal to the senses. But the question is bound to arise: "What is the relation of this to real geometry? What has it to do with the space of which we have experience, with the practical measurements which we are making every day?" To answer this inquiry in anything like a satisfactory way it is necessary to clear our mind of prejudices and misconceptions which obscure the whole matter until they are removed.

First of all it must be remembered that we cannot distinguish between real and imaginary space in the same sense as we do, for instance, between a real experience and an hallucination, or between a photograph and a landscape composition. Space is *essentially* an ideal conception, and strictly speaking we have no experience of space at all; we evolve, each of us probably with his own degree of precision or vagueness, a scheme to which we relate certain aspects of our sense-impressions. To attempt to define real space as the space in which real things exist is, of course, mere playing with words and avoiding the true issue; when we say that a thing "exists in space," we refer an actual (or imagined) objective experience to an ideal scheme, and our statement has a meaning for us simply so far as the scheme is clearly developed *in subjecto*. Again, to say that real space is of three dimensions, as contrasted with the n-dimensional space of abstract analytical geometry, merely means that, hitherto, a three-dimensional scheme has proved sufficient for the classification of those sense-impressions which admit of a spatial interpretation. It is a very interesting experiment to walk along a street and attend exclusively to one's visual impressions; this gives a consistent experience of a *two*-dimensional space with a time-series of continuous projective transformations. The exhibitions of "animated photographs" afford a similar experience; the conclusion seems obvious that the properties of "real" space are conditioned by the range of sensations that we refer to it. Supposing that we could develop a new sense, it is quite possible that we might experience a "real" space of four dimensions.

From the purely mathematical side these discussions are more or less irrelevant. The definition of a positional manifold of n dimensions is perfectly clear and intelligible; and it is quite legitimate to assume such postulates of construction as will make the corresponding geometry just as much a true geometry as the elements of Euclid. Of course, if $n>3$, we lose the help of "intuition," that is, the suggestions of sense-impressions; but these suggestions are not essential, and the modern development of geometrical theory is, in fact, chiefly due to a sceptical criticism of the crude results of merely objective experience.

Then, again, as to the metrical properties of space. The analytical theory leads, as we have seen, to three distinct varieties. No conceivable experiment can decide whether "real" space is elliptic, hyperbolic, or parabolic: one sufficient reason is that it is pure assumption to suppose that we can move a ruler about without altering its length. It is enough for all practical purposes to know that the hypothesis of parabolic space is comparatively simple, and serves nearly enough for the interpretation of physical measurements. In this connection, special attention may be directed to Mr. Whitehead's notes on pp. 499 and 451. The last is particularly important, as pointing out that a space of one type may be a locus in a space of one more dimension and of a different type: thus ordinary Euclidean space of three dimensions may be regarded as a limit-surface in a hyperbolic space of four dimensions.

On p. 369 will be found a very useful bibliography of treatises and memoirs dealing with the general theory of metrics; one omission that may be noted is that no reference is given to Lie's large treatise on transformation-groups, which contains a section on this subject, with detailed criticism of the theories of Riemann, Helmholtz and others.

It would not be right to conclude this notice without saying a word or two in appreciation of the spirit of thoroughness and of independence in which Mr. Whitehead's valuable book has been written. It possesses a unity of design which is really remarkable, considering the variety of its themes; and the author's own contributions, not only in illustrative detail, but in additions to the general theory, are well worthy of attention. All who are interested in the comparative study of algebra will look forward with pleasurable anticipation to the appearance of the second volume, and wish the author all success in bringing his formidable task to a conclusion.

G. B. M.

EARLY GREEK ASTRONOMY.

The First Philosophers of Greece. An edition and translation of the remaining fragments of the pre-Sokratic philosophers, together with a translation of the more important accounts of their opinions contained in the early epitomes of their works. By Arthur Fairbanks. Pp. vii + 300. (London: Kegan Paul, Trench, and Co., Ltd., 1898.)

THE histories which we possess and to which we readily turn for information concerning the early science of the ancients have been prepared mainly by two kinds of writers, having in view two different objects. We have on the one hand, works like those of Delambre, or in later times of Mr. Narrien, authors possessing a comprehensive knowledge of mathematical analysis, and who, writing for the benefit of physicists, are most interested in exhibiting the scientific connection existing between the older philosophers and modern science. As an example of the other kind, we may refer to such works as that by Sir G. C. Lewis, whose classical attainments were probably in advance of his knowledge of physics,

and who looked upon the writings of the ancients from the point of view of a student of ethics and philosophy. He addressed a wider and less specially educated class, whose interest in his book was perhaps more literary than scientific. Neither method of exhibiting the extent of ancient knowledge is free from objection. In either case the original is liable to be coloured or distorted by the views of the commentator. The modern serious student desires to consult original authorities, and takes but little interest in compilations, however thorough, by authorities, however competent. The work of Mr. Fairbanks will therefore be welcome to that class of students, who are anxious to know what the various authors have said themselves, not merely the interpretation which later writers have put upon these utterances. These original sources of information are too often only to be found in short fragments scattered liberally throughout Greek literature in the form of quotations from the earliest writers, or more or less complete epitomes of the masters' teaching, prepared by later writers. German criticism has been busy with these fragments, determining the relation of these writers to each other as well as to the source of the whole series, in order that we may estimate their relative value. The Greek text of these fragments has been published in numerous short monographs, most of which, however, are not easily accessible, and a competent guide is necessary. This essential service Mr. Fairbanks has rendered to the student by placing the materials ready to his hands. He has, moreover, prepared a carefully constructed text, enriched it by critical notes, and added an English translation. Important passages from Plato and Aristotle bearing on these early writers are also given, so that even the better known authorities gain some illumination. Mr. Fairbanks puts before us all the material for the survey of the history of early Greek thought; we necessarily confine our attention to the physical side.

It is interesting to inquire whether the reputations of certain philosophers, and the estimate we have formed of their scientific insight, should be modified by a critical study of the original description apart from the interpretation which later authors have given to these expressions. We are too apt to quote over and over again the expressed opinions of writers of repute, without re-examining the grounds on which those opinions rest. We may unconsciously attach too much weight to the comments of later writers who have been swayed by tradition, and who, in the absence of exact information, drawn from trustworthy sources, have inserted their own views in the place of the original. Unfortunately, in some cases, and these the most interesting, no fresh information is forthcoming. Thales, the founder of the Ionian school, for instance, remains as mythical and unsubstantial as ever. He looms large on the distant background owing to his connection with the famous eclipse to which his name is attached, and the part it has played in scientific chronology, but neither ingenuity nor research seems likely to afford a satisfactory answer to the several enigmas connected with his history. Anaximandros and Anaximenes scarcely fare better. It is generally agreed that two short phrases have been taken directly from the writings of the former, but even admitting the probability, neither of these expressions is calculated to throw much light on his teaching or illustrate any distinctive feature in the cosmical tenets which he propounded. It is not till we come to Herakleitos that we meet with any large number of original extracts. The preservation of these quotations may be due to chance, or may be held as evidence of the greater veneration in which his teaching was held. The student of Plato is acquainted with a few of his sayings which had passed into the character of proverbs, and attest the popularity of the author The complete collection presented to us by Mr. Fairbanks does not appear very edifying. Some, indeed, have the solemnity of the Proverbs of Solomon, while others well maintain that reputation for obscurity which the author early acquired and consistently retained. As an acute observer and scientific teacher, Herakleitos falls far behind Thales, or rather behind the position popularly assigned to Thales, for which, however, we get here little additional support. The suspicion that Herakleitos believed the sun to be no larger than a human foot is confirmed, and it seems probable that he taught that the sun and moon were both bowl-shaped. Eclipses were produced by the turning of these bowl-shaped bodies, so that the concave side was turned upwards and the dark convex side was seen by the observer. Following, however, the reconstructed "Placita of Aetios," probably the original work from which both Stobaeos and Plutarch copied, the earlier master taught that the eclipses of the sun took place when the moon passed across it in direct line, and that eclipses of the moon proved that it came into the shadow of the earth: the earth coming between the two heavenly bodies and blocking the light from the moon. Whether Thales really taught these advanced views himself is immaterial; the fact remains that these correct notions did obtain at a very early date, and it is very difficult to understand how, in any enlightened society, they were supplanted by the childish formulas recited by Herakleitos and his admirers. The scientific teaching of the school of Thales seems to have been at its best at its birth and to have rapidly deteriorated, authority possibly usurping the place of observation.

The Eleatic school, however, had much to learn. Xenophanes, the founder, was not happy in his scientific suggestions. According to the authority just quoted, this philosopher taught that the stars were formed of burning cloud, extinguished each day and re-kindled at night. This seems to be a fair sample of his teaching, and his name and his work may be rapidly passed aside. Parmenides, probably the disciple of Xenophanes, is entitled to more respectful consideration, both by reason of the regard in which he was held by Plato and by the correctness of his views on certain scientific points. From a passage in Stobaeos he has been credited with having taught that the earth was spherical in shape, but some doubt has existed, inasmuch as the same writer attributes the same discovery to Anaxagoras. Modern research seems to declare on the side of Parmenides, but the evidence is by no means clear.

Other teachers come under review, notably Pythagoras, from whom we have no preserved quotation, though the doxographists have much to say of him, and of Empedocles, who has much to say, both in his own words and those of others. But the reading of even the longest extracts does not leave a very satisfactory impression. It

is impossible to feel that the quotations that have been preserved are those that are most characteristic of the master, or those by which he himself would wish to be judged. Some happy expression, some lucky chance may have attracted the attention of a pupil or a commentator, with the result that we get transmitted to us a very imperfect view, and consequently we utterly fail to reconstruct any adequate picture of the philosophical teaching as a whole. If Plato, writing of Parmenides, almost a contemporary, could say "I fear lest we may not understand what he said, and that we may fail still more to understand his thoughts in saying it," how much more difficult is it for us to obtain a clear conception. But this difficulty does not detract at all from the value of Mr. Fairbanks' work, or of those who have laboured in the field of literary criticism. In entering into their labours we learn with clearer precision the extent and the trustworthiness of the materials that exist for the study of early Greek thought.

A HUNDRED AND FIFTY NORTH AMERICAN BIRDS.

Bird Neighbors: an Introductory Acquaintance with One Hundred and Fifty Birds commonly found in the Gardens, Meadows, and Woods about our Homes. By Neltje Blanchan; with Introduction by John Burroughs. Pp. viii + 234. Coloured plates. (London: Sampson Low, Marston, and Co., Ltd., 1898.)

AT the first glance this volume might well be mistaken for an addition to the already extensive literature relating to British birds; but the spelling of the second word in its somewhat cumbersome title at once proclaims its Transatlantic origin. And, as a matter of fact, it is really a popular account of some of the commoner birds of the United States. Since it is confessedly printed in New York, it is doubtless an English edition of a work first published in the States; and although it may be most useful in the land of its birth, we may perhaps be permitted to suggest that it would have been better had its issue been restricted to that country.

On first opening the book the reader is confronted with a frontispiece purporting to represent the "Goldfinch," but instead of seeing the bird properly so denominated, he finds the so-called American Goldfinch (*Spinus tristis*). And, although the bird's proper title is given in the text, the plate, for issue in this country, ought to have been similarly lettered. This is by no means a solitary instance as regards the legends to the plates; while in the systematic part it is even worse. We find, for instance, the Hangnests, or *Icteridæ*, popularised under the names of blackbirds and orioles; while in the family (*Turdidæ*) to which the birds properly so-called belong, we have, in addition to thrushes, bluebirds and robins. Doubtless this is good enough for a country in which bison are miscalled buffalo, and stags of the red deer group elk, but it will scarcely commend itself to English readers.

In her preface the lady author lays great stress on the circumstance that "her knowledge has not been collected from the stuffed carcasses of birds in museums [as if any one examined *stuffed* specimens for descriptive purposes], but gleaned afield." And in the introduction it is written:—"The pictures, with a few exceptions, are remarkably good and accurate, and these, with the various groupings of the birds according to colour, season, habitat, &c., ought to render the identification of the birds, with no other weapon than an opera-glass, an easy matter."

It would be distinctly interesting to know which were the exceptions above referred to. Was the plate of the Yellow-throated Vireo, facing p. 189, one of them? In this plate we have an obviously stuffed example (and not a very well stuffed one at that) of the bird in question, mounted upon one of the conventional museum perches. The bird thus mounted has been fixed in the most glaringly obvious manner to one of a series of twigs of apple in blossom, and the whole reproduced as a picture. Apart from the perch, the general effect might not have been utterly bad, were it not that the twigs are placed in the vertical when they should have been in the horizontal position!

But there are even things artistically worse than this. Many of the plates, such as those of the Bobolink and the Brown Thrasher, appear to have been produced by taking a landscape and placing in front of it either a single (apparently stuffed) bird or a group of birds, and then, by some process unknown to us, reproducing the whole. And the effect is not pleasing. Either the objects in the background stand out as though they formed the middle distance, or they are hopelessly out of focus and form a confused blurr. As already said, the author inveighs against stuffed "carcasses," but if the Blackcap-Tit, or "Chickadee," forming the subject of the plate facing p. 76, does not come under such designation, we shall be greatly surprised.

Neither can we commend the arrangement of the birds described. At the commencement of the book these are placed under their proper families, and to our thinking no better arrangement could have been followed in the sequel. But this by no means suits the author. And after a little preliminary skirmishing in the way of classing by habitats, season, and size, she finally settles down to arrange the species by coloration! Consequently we have closely allied forms widely separated, and incongruous species placed in juxtaposition, without, so far as we can see, one single advantage gained over the ordinary system. To take an example, we have two species of woodpeckers placed among birds "conspicuously black and white," where they are flanked on each side by a passerine, but a third woodpecker (the "flicker") finds a far distant place among "brown, olive, or greyish-brown, and brown and grey sparrowy birds." Surely this is making confusion for confusion's sake.

Much more sympathy may be expressed for the author's attempt to divide the birds of New York according to whether they are permanent residents, or make their appearance at particular seasons only; and this list may prove of use not only to the ordinary bird-lover, but likewise to the student of migration and distribution. As regards the descriptions of the different

species, these appear fairly accurate; and many little anecdotes of habits, &c., are related in a manner which can scarcely fail to attract attention.

Although both from the artistic and the strictly scientific standpoints, the volume, in our judgment, is somewhat of a failure, yet as an earnest and brightly-written attempt to popularise the study of the commoner North American birds, it is deserving of attention on the part of residents in the States who want to know more about the ways of the feathered creatures with which they meet. R. L.

OUR BOOK SHELF.

Symons's British Rainfall, 1897. By G. J. Symons, F.R.S., and H. Sowerby Wallis. Pp. 58 + 239. (London: Edward Stanford, 1898.)

AN interesting article on the mean annual rainfall in the English Lake district appears in this new volume of "British Rainfall," in continuation of articles published in the volumes for the years 1895 and 1896. The earlier contributions showed the rainfall at Seathwaite from 1845 to 1895, and the rainfall within an area of about thirty square miles having Seathwaite nearly in the centre. In the present volume a much larger area—about 650 square miles—is dealt with from the point of view of rainfall, and a number of noteworthy conclusions are reached. The paper is accompanied by an orographical map, and a map showing by means of isohyetal lines—that is, lines of equal mean annual rainfall—the distribution of the precipitation in the district. This map shows that annual rainfalls exceeding 100 inches occur over more than seventy square miles. A high rain fall appears to be established at the head of the Langdales, trustworthy observations giving a mean of 129·7 inches at Mickleden, which value is within five inches of the rainfall at Seathwaite.

Mr. Symons points out that the rainfall differs very greatly, even within a few miles. An examination of the records of three pairs of stations, separated by $3\frac{1}{2}$, $2\frac{1}{2}$, and $1\frac{1}{4}$ miles respectively, showed the increase per mile to be 28 inches, 21 inches, and 71 inches respectively, the last-named representing a difference of 0·04 inch per yard.

Heavy rains in short periods appear to have been more frequent in 1897 than they generally are. Large rainfalls in twenty-four hours were also noteworthy. One of the heaviest rains on record in the United Kingdom occurred at Seathwaite on November 12, 1897, the fall in twenty-four hours ending at 9 a.m. on November 13 being 8·03 inches—that is, more than half an inch greater than any diurnal record during fifty-three years. As to the relation which the total fall of rain in 1897 bears to the average amount, Mr. Symons finds that, for England and Wales, and Scotland as a whole, the fall in 1897 was the same as the average fall for the period 1880–89, but in Ireland it was twelve per cent. in excess.

The number of observers who now send their records to Mr. Symons is 3318, and credit is certainly due to him for the organisation of this vast staff, and to the authors combined for their work of reducing the observations to law and order.

Storia Naturale, per la gioventù Italiana. By Achille Griffini, Assistant at the Royal Zoological Museum, University of Turin. Pp. 720. (Milan: Ulrico Hoepli, 1898.)

ENCYCLOPÆDIAS in one volume are not much in vogue in England, and this one needs but a short notice. It embraces the whole range of zoology, botany, and mineralogy, and seems to be the result of much laborious compilation and condensation. But surely such labour is all but thrown away; such a book can never really interest young people, or train them in the habit of attention and observation. If a new butterfly or fossil be met with, the book may perhaps be consulted, but will in all likelihood be found either to have omitted the species altogether, or to have given so inadequate a description as to make identification a mere guess-work. This is no fault of Dr. Griffini, who has worked conscientiously, and has been obliged, as he says with a sigh, to suspend all his scientific research during the composition of the book: it means simply that it is impossible in the given space to deal with any one species in a way that can be called either scientific or interesting. Here is an example—a description of one of the most singular and beautiful birds in Europe:—

"*Tichodroma muraria* (the wall-creeper), length 17 cm., of an ash-grey colour with red and black wings: the male has a black throat, but in the female this is whitish. It lives on the tops of the Alps and Apennines, climbs with agility, often poises itself on its wings during flight, and feeds on insects."

This account may be said to be devoid of all the qualities which should attract the "gioventù Italiana," or fix this curious bird in their memories: it is incomplete and inaccurate, as well as uninteresting; and it is obvious that the writer had never seen the bird alive. But many species are much more minutely described, and illustrated by very fairly good woodcuts, which are better than the coloured plates containing each a large number of species crammed into a small space. And there is no doubt a certain advantage to beginners in having a survey of the whole field of natural history for purposes of classification as well as ordinary reference. Yet for helping the beginner and awakening his interest, our own plan of issuing a series of handy volumes seems far better both for authors, readers, and publishers.

Iowa Geological Survey. Vol. vii. Annual Report, 1896, with accompanying papers. Pp. 555. (Des Moines: Iowa Geological Survey, 1897.)

THE papers in this report contain descriptions of the geological characteristics of six counties in Iowa, namely, Johnson and Cerro Gordo Counties, described by Dr. Samuel Calvin, State Geologist; Marshall County, by Dr. S. W. Beyer; Polk and Guthrie Counties, by Mr. H. F. Bain; and Madison County, by Prof. J. L. Tilton and Mr. H. F. Bain. These counties are geologically important in regard to both indurated rocks and superficial deposits, and the report upon them, with the many maps and diagrams, will be found of interest and service to the people of Iowa.

In addition to the counties reported upon in the present volume, a large amount of other work is referred to in the administrative report. Thus, investigations undertaken with the object of determining the distribution of certain types of soil and their relation to the drift-sheets covering the State, have incidentally demonstrated that the succession of Pleistocene deposits is more complete and more clearly indicated in Iowa than in any other corresponding area of the North American Continent so far studied. Another interesting subject referred to is the discovery of a remarkable fish fauna in an old slate quarry in Johnson County. The beds in which the remains occur are of Devonian age; but it is said that no such assemblage of Devonian fishes has hitherto been found in North America, or in the world. The material has been placed in the hands of Dr. C. R. Eastman, of the Museum of Comparative Zoology, Cambridge, Massachusetts, who has undertaken to study it.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

What is "Anlage"?

THE necessity of finding an adequate translation of this indispensable German expression becomes more, rather than less, pressing as time goes on. To be obliged, on every occasion, to write "Anlage" in inverted commas, is a standing testimony to the deficiency of our scientific homenclature, and a constant offence to our æsthetic susceptibilities. It is true that there are other terms which have been spasmodically employed to convey the conception contained in "Anlage." But these terms are either inadequate, unsightly or inaccurate. "Forecast" is inadequate, "fundament" is unsightly, while "rudiment" is inaccurate. I will not insist further upon the impropriety of the use of the words "forecast" and "fundament," but will proceed to explain why, in my opinion, "rudiment" is an inaccurate rendering of "Anlage" It is not so much that an "Anlage" of an organ is not a "rudiment" of that organ, as that the rudiment of an organ is generally something different from its "Anlage."

This point is best illustrated by considering a somewhat extreme case, or at least one which is a matter of common observation. The budding limbs of the embryo of a quadrupedal vertebrate are rudiments of the pentadactyle appendages which have their origin in the internal "Anlagen" of those structures. Thus the "Anlagen" are aggregations of embryonic cells which, by their growth and division, give rise to rudiments, and the latter, in their turn, give rise to the finished organs. So that, far from being identical with an "Anlage," a rudiment arises from an "Anlage," and is the middle stage in organogeny.

As the organs of the animal body are built up of tissues, and these of cells, so, in their development, they spring from rudiments, and these from "Anlagen."

This analogy may be represented as follows:—

Anatomy.	*Development.*
Organs—tissues—cells.	"Anlagen"—rudiments—organs.

In some cases, no doubt, it would not be necessary to make a fine distinction between "rudiment" and "Anlage," but in others it is undoubtedly necessary; and it is for such cases that one has to be prepared with a suitable technical term.

The essentials of a good term are that it should be new, precise and Latin.

The word that commends itself to me as being at once accurate and well-sounding is *primordium*, and I trust some of your readers will criticise it whether favourably or unfavourably.

The conception embodied in the word "Anlage" recurs so frequently in our science, that it seemed of sufficient importance to invite attention to the matter in the columns of NATURE.

New Museums, Cambridge, August 16. ARTHUR WILLEY.

"Animal Intelligence."

IN a review of my monograph on "Animal Intelligence," in a recent number of NATURE, Mr. Lloyd Morgan credits me with upholding the theory that we have sensations caused by outgoing currents which innervate muscles, and with depending on that theory in some of my own statements about the nature of animals' consciousness. A careless and ambiguous sentence of mine was responsible for this. I believe with Mr. Morgan that the feelings which go with innervations of the muscles are due to currents *coming back from* the muscles or joints and tendons, and do not think that any of my conclusions in any way involve an acceptance of the other theory. Such sensations due to return currents (together with the images built up from them) were just what I meant by the phrase which he quotes, "the consciousness accompanying a muscular innervation apart from that feeling of the act which comes from seeing oneself move, &c." It was because I presupposed general agreement in accepting the return-current theory that I was so careless as to leave the obvious ambiguity. EDWARD L. THORNDIKE.

Cambridge, Mass., U.S.A., August 3.

I NEED hardly say that I sincerely regret the unwitting misrepresentation of Mr. Thorndike's meaning. But I may be allowed to add, in self-defence, that the "careless and ambiguous sentence" forms part of the *definition* of "impulse," and that the exclusion of "feeling one's own body in a different position, &c.," is emphasised by italics. I am glad to find that Mr. Thorndike's interpretation and my own are thus yet more closely in accord than I supposed, and shall look forward to more experiments and further discussion in the field of "Animal Intelligence" from him. C. LLOYD MORGAN.

A Tooth of *Hybodus grossicornis* from the Inferior Oolite.

SOME time ago I found in one of the lowest strata of the Inferior Oolite, a tooth of the *Hybodus grossicornis.* The bed occurred at Haresfield Beacon, near Gloucester. The following section of this hill is given by Mr. E. Witchell, of Stroud:—

Freestone: Ferruginous concretionary marl, 1 foot 6 inches; ferruginous brown hard sandstone, 8 feet; oolitic ferruginous bed, 2 feet; Cephalopoda beds, 2 feet 6 inches.

Below these beds are the Cotteswold Sands, resting upon Upper Lias. The tooth was found in the freestone bed, the characteristic fossils of which are Ostrea, Lima, Terebratula, various small Gasteropoda and Crinoids

The species of the fossil has been kindly determined by Prof. Newton. THOS. BEACALL.

Quedgeley, Gloucester, August 19.

Iridescent Clouds.

YOUR correspondent Mr. W. Larden, writing on the subject of solar halos (p. 344), referred also to rose-crimson and green colours on clouds. It is quite unnecessary to be at 6000 feet altitude to observe iridescent clouds, for we do so frequently here during the summer months, at about 350 feet above sea-level. They appear generally about an hour before sunset and cease at sunset, and we always look out for them when seeing the suitable kind of delicate cirrus cloud in fine wavy fleecy streaks in the sky near the sun at the right hour; and are generally rewarded by the sight of the exquisite rose and green ripples of nacreous brilliancy, affording a striking contrast to the ordinary sunset colouring. E. ARMITAGE.

Dadnor, Herefordshire, August 16.

Distant Thunderstorms affecting Flowers.

AT Malvern we felt none of the thunderstorms of Thursday, August 18, and the following night; but some freshly-cut sweet peas shrivelled, and did not recover their beauty until the morning of the 19th. The nearest storms must have been at Cardiff and Bristol. ROSEMARY CRAWSHAY.

INTERNATIONAL CONGRESS OF ZOOLOGISTS.

THE Fourth International Congress of Zoology, which opened at Cambridge on Tuesday morning, August 23, promises to be the most successful meeting yet held. This is the first occasion that the Congress has met in England, and the proportion of English members assembled to extend a welcome to the foreign zoologists is, as it should be, considerable. The Congress is a triennial one, and has already met at Paris, Moscow and Leyden. The increasing popularity with which the meetings are regarded by zoologists may be gauged by the progressive increase in the number of members attending. Only sixty members were present at the Paris Congress in 1889, 120 at Moscow, and 200 at Leyden; the number participating at the present meeting has already exceeded 280. Among the distinguished visitors present are Dr. Anton Dohrn (Naples), Prof. E. Ehlers (Göttingen), Prof. L. von Graff (Graz), Prof. Haeckel (Jena), Prof. E. L. Mark (Cambridge, Mass.), Prof. O. C. Marsh (New Haven), Prof. A. Milne-Edwards (Paris), Prof. K. Mitsukuri (Tokyo), Prof. Ramsay-Wright (Toronto), Prof. W. Salensky (St. Petersburg), Prof. F. E. Schulze (Berlin), and Prof. J. W. Spengel (Giessen). Much disappointment is felt at the absence through ill

health of Prof. Carus, Prof. Ray Lankester and Sir William Flower. Sir William Flower, it will be remembered, was, at the conclusion of the Leyden Congress in 1895, made President-Elect for this Cambridge meeting; but he relinquished the presidency in favour of Sir John Lubbock, in the early part of the present year, on account of failing health. Sir John Lubbock opened the Congress on Tuesday morning by a short address, which is here printed in full. The members of the Congress who arrived at Cambridge on Monday evening were received at the Guildhall by the Mayor of Cambridge and by the Vice-Chancellor of the University, who, in a short speech begun in English, continued in German, and concluded in French, welcomed the visitors and expressed the best wishes of the town and the University for the success of the meeting.

The following is the President's address:—

My first duty to-day is to welcome our foreign friends who have done us the honour to attend the Congress. I may do so, I know, on behalf of all English zoologists. They will, I hope, find much to reward them for their journey. It will have been to them, as it is to us, and to no one more than myself, a matter of profound regret that Sir W. Flower, who had been nominated as our President, found himself unable to accept the post. Our regret is the keener on account of the cause, but I am sure that we all hope that rest and change of air will secure him a renewal of health. I am painfully conscious how inadequately I can fulfil his place, but my shortcomings will be made up for by my colleagues, and no one could give our foreign friends a heartier or more cordial welcome than I do.

The first Congress was held at Paris in 1889, and was worthily presided over by Prof. Milne-Edwards, whom we have the pleasure of seeing here to-day. The second Congress was held at Moscow in 1892, under the Presidency of Count Kapnist, and under the special patronage of his Imperial Highness the Grand Duke Serge. The third Congress was at Leyden in 1895, under the Presidency of Dr. Jentink, Director of the Royal Museum, and under the patronage of the Queen Regent. We assemble here to-day under the patronage of H.R.H. the Prince of Wales, with the support of Her Majesty's Government, and under the auspices of the University of Cambridge.

Such meetings are of great importance in bringing together those interested in the same science. It is a great pleasure and a great advantage to us to meet our foreign colleagues. Moreover, it cannot be doubted that these gatherings do much to promote the progress of science.

What a blessing it would be for mankind if we could stop the enormous expenditure on engines for the destruction of life and property, and spend the tenth, the hundredth, even the thousandth part, on scientific progress. Few people seem to ealise how much science has done for man, and still fewer how much more it would still do if permitted. More students would doubtless have devoted themselves to science if it were not so ystematically neglected in our schools; if boys and girls were not given the impression that the field of discovery is well-nigh exhausted. We, gentlemen, know how far that is from being the case. Much of the land surface of the globe is still unexplored; the ocean is almost unknown; our collections contain thousands of new species waiting to be described; the life-histories of many of our commonest species remain to be investigated, or have only recently been discovered.

Take, for instance, the common eel. Until quite recently its life-history was absolutely unknown. Aristotle pointed out "that eels were neither male nor female," and that their eggs were unknown. This remained true until a year or two ago. No one had ever seen the egg of an eel, or a young eel less than 5 centimetres ($1\frac{1}{4}$ inches) in length We now know, thanks mainly to the researches of Grassi, that the parent eels go down to the sea and breed in the depths of the ocean, in water not less than 3000 feet below the surface. There they adopt a marriage dress of silver and their eyes considerably enlarge, so as to make the most of the dim light in the ocean depths. In the same regions several small species of fish had been regarded as a special family, known as Leptocephali; these also were never known to breed. It now appears that they are the larvæ of eels; the one known as *Leptocephalus brevirostris* being the young of our common fresh-water eel. When it gets to the length of about an inch, it changes into one of the tiny eels known as elvers, which swarm in thousands up our rivers. Thus the habits of the eel reverse those of the salmon.

I will only take one other case, the fly of the King Charles oak apple so familiar to every schoolboy. In this case the females are very common; the eggs were known. But no one had ever seen a male. Hartig in 1843 knew twenty-eight species of Cynips, but in twenty-eight years' collecting had never seen a male of any of them. He and Frederick Smith between them examined over 15,000 specimens of *Cynips disticha* and *C. Kollari*, and every one was female. Adler, however, made the remarkable discovery that the galls produced by these females are quite unlike the galls from which they were themselves reared; that these galls produced flies which had been referred to a distinct genus, and of which both males and females were known. Thus the gall-flies from the King Charles oak apple (which are all females) creep down and produce galls on the root of the oak from which quite a dissimilar insect is produced, of which both sexes occur, and the female of which again produces the King Charles oak apple. This is not the opportunity to go into details, and I merely mention it as another illustration of the surprises which await us even in the life-history of our commonest species.

Many writers have attributed to animals a so-called sense of direction. Some species of ants and bees certainly have none. Pigeons are often quoted, but the annals of pigeon-flying seem to prove the opposite; they are "jumped," as it were, from one point to another. We know little about our own senses—how we see or hear, taste or smell; and naturally even less about those of other animals. Their senses are no doubt in some cases much acuter than ours, and have different limits. Animals certainly hear sounds which are beyond the range of our ears. I have shown that they perceive the ultra-violet rays, which are invisible to us. As white light consists of a combination of the primary colours, this suggests interesting colour-problems. Many animals possess organs apparently of sense, and richly supplied with nerves, which yet appear to have no relation to any sense known to us. They perceive sounds which are inaudible to us, they see sights which are not visible to us, they perhaps possess sensations of which we have no conceptions. The familiar world which surrounds us must be a totally different place to other animals. To them it may be full of music which we cannot hear, of colour which we cannot see, of sensations which we cannot conceive.

There is still much difference of opinion as to the mental condition of animals, and some high authorities regard them as mere exquisite automata—a view to which I have never been able to reconcile myself. The relations of different classes to one another, the origin of the great groups, the past history of our own ancestors, and a hundred other problems, many of extreme practical importance, remain unsolved. We are, in fact, only on the threshold of the temple of science. Ours is, therefore, a delightful and inspiring science.

We are fortunate in meeting in the ancient University of Cambridge, a visit to which is, under any circumstances, delightful in itself from its historic associations, the picturesque beauty of the buildings, and as the seat of a great zoological school under our distinguished colleague, Prof. M. Foster.

The University has given us a most hospitable reception, for which we are very grateful. This morning will be devoted to business and the receipt of reports. In the afternoon will be held the first meeting of Sections, and to-night the Vice-Chancellor has been good enough to invite us to Downing College. To-morrow morning will be devoted to a discussion of the position of sponges in the animal kingdom, and in the evening there will be a conversazione in the Fitzwilliam Museum. Thursday we are looking forward to a discussion on the origin of Mammals. For Friday we have a number of interesting papers. On Saturday morning we shall have to determine the time and place of the next meeting, and then we adjourn to London.

The President and Council of the Zoological Society have invited us to visit their gardens in the afternoon; and in the evening, by the kind permission of the Trustees, I am permitted to invite your presence to a party at the Natural History Museum.

The Central Hall only will be open that evening, but on the following day you will have the opportunity of visiting the whole Museum.

In the evening the President and Committee of the Royal

Societies' Club hope to have the pleasure of seeing you at their house in St. James-street.

Monday the Museum of the College of Surgeons will be thrown open, and will be found well worth a visit. Mr. Rothschild has also kindly invited us to see his rich museum at Tring.

Tuesday the Duke of Bedford will show his collection of Cervidæ at Woburn, and there will be excursions under the auspices of the Director of the Marine Biological Laboratory at Plymouth, and of Prof. Herdman at Port Erin.

I trust, therefore, that you will have a delightful and interesting week, and that our foreign friends will carry back with them pleasant recollections of their visit here, which may induce them to return again in some future year.

THE BRITISH ASSOCIATION.

THE preparations for the meeting in Bristol are well in hand, and by September 7 everything will be in order for the reception of visitors. It is, of course, impossible to say at present whether the meeting will be a big one, but it is expected to be, and the Executive Committee are prepared for any emergency which may arise on this score. It is not improbable, taking all things into consideration, that many will avail themselves of coming to Bristol. Owing to the distance that the meeting was held from London last year, some certainly could not spare the time for a visit to Canada, and so will take special pains to be present this year. There happen, too, to be several unusual attractions. The opening of the Cabot Tower, though not strictly speaking connected with the Association, has been fixed for Tuesday, September 6, and will no doubt influence many Canadians and other American visitors to come to Bristol. The Marquess of Dufferin will perform the ceremony, and be present at the dinner in the evening. The International Conference on Terrestrial Magnetism will also meet during the Association week, and there will also be a Biological Exhibition in the Clifton Zoological Gardens, which cannot fail to be of interest. Lastly, and by no means leastly, the high reputation Bristol and the neighbourhood has for objects of interest—geological, botanical, and archæological—together with the well-known beauty of the place and the hospitality of its citizens, will induce many to attend the 1898 meeting, combined with the additional attraction of a visit from part of the Channel Fleet.

The reception room will be at the Victoria Rooms in the large hall, and will contain the usual counters for obtaining tickets, &c., post office, and conveniences for writing; this latter being in the gallery, access to which is obtained by a wide staircase. The small hall will be devoted to the gentlemen's smoking room, where tea and coffee can be obtained. The room known as Alderman Daniel's, with two others, will be given over to the ladies, the rooms being suitably furnished. The local hon. treasurer and secretaries will also have their office in the Victoria Rooms.

The Directors of the Victoria Rooms Company have, in reply to a request, redecorated a large part of the building, so that the appearances are all that could be desired. Cloak room for gentlemen, typewriting rooms, telephone, and a newspaper stall are all provided.

Luncheons can be obtained at the Grammar School, hard by the Victoria Rooms, and at the premises of the late Salisbury Club, which latter building will also accommodate the press and General Committee at their meetings. Lunch can also be obtained at several restaurants near.

In the Drill Hall will be an exhibition of pictures, ancient armour, and Bristol china and other objects of interest; while the band of the Royal Horse Artillery will play there each afternoon from 4 to 6. In the event of wet weather this place will be very convenient; but wet or fine, it will form a comfortable lounge for those who do not wish to go to garden parties.

The section rooms are well situated, and are mostly near the reception rooms, the furthest not being any considerable distance.

Section A will meet in the Lecture Theatre of the Museum, kindly lent by the Corporation; Section B in the British University College; Section C in the Hannah More Hall, Park Street; Section D in the Victoria Chapel Schoolroom; Section E in the Concert Room of the Blind Asylum; Sections F and G in the Merchant Venturers' Technical College; Section H in the Roman Catholic Schoolroom; Section K in the Fine Arts Academy.

All the Bristol and Clifton Clubs have thrown their doors open to visitors, and at the Clifton College and Corporation Baths members can have an early swim if they desire it.

The presidential address and evening lectures will be delivered in the Colston Hall; the working men's lecture in the hall of the Young Men's Christian Association, St. James Square.

Two conversaziones will be given: one by the Chairman of the Council (the Lord Bishop of Hereford), the head master of Clifton College, and Mrs. Glazebrook, at Clifton College, on September 8; the other by the local committee, in the Colston Hall on the 13th.

As well as the Cabot dinner two others will be given: the Chamber of Commerce on the 10th, the Master and Society of Merchant Venturers on the 13th; and a smoking concert will be given in honour of the President at the Merchant Venturers' Technical College on the 9th.

During the week, eight garden parties will be given to the members of the Association, several of the houses where they are to be held having most beautiful views of the Avon and Severn. As regards the usual literature that will be distributed, the handbook will not be of the bulky though excellent type of the 1875 one; it will be a more compact work, printed on thin but strong paper, and the articles, which are written by local authorities on the various subjects, as complete and full as space will permit. This work was completed more than a month ago.

The excursions guides are being framed on the lines laid down by the Manchester Committee a few years ago. Each of the eighteen excursions is printed as a separate booklet, but all are enclosed in a stout cloth cover and held by a band. The map, for only one will be given, is a new one, just published by Philip, of Liverpool, and will be coloured to show the geology of the district.

GLYPTIC AND GRAPHIC ART APPLIED TO PALÆONTOLOGY.[1]

THE Trustees of the American Museum of Natural History have undertaken a most useful work, in providing casts of a number of vertebrate fossils, obtained during recent years, from the Tertiary and Secondary deposits of North America, many of which can only be represented by this means in foreign museums.

But they have done even more than this; for, possessing on their staff men of artistic talent, as well as anatomical knowledge, they have set to work and produced a series of models of some of the extinct monsters of the Permian, Cretaceous and Tertiary rocks of North America, restored by Mr. Charles Knight with suggestions and criticisms by the late Prof. E. D. Cope, and by Prof. Osborn and Dr. Wortman. These models (which are on a scale suitable for a small museum or lecture-table), have been executed in plaster by Mr. Jacob Gommel. Only five are at present ready for dis-

[1] "Casts, Models, Photographs, and Restorations of Fossil Vertebrates," Department of Vertebrate Palæontology, American Museum of Natural History; Central Park, New York, U.S.A. Henry F. Osborn, Curator; J. L. Wortman and W. D. Matthew, Assistant Curators. 8vo. Pp. 24 7 illustrations).

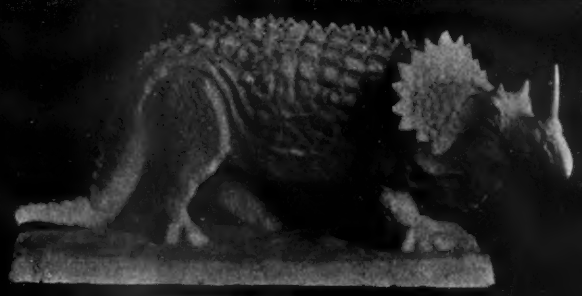
tribution, at prices varying between ten dollars and thirty dollars each; they represent:—

Fig. 1, *Agathaumus* (*Triceratops*) *sphenocerus* (Cope), a large heavily armed herbivorous Dinosaur from the Laramie Upper Cretaceous of Western America; the length of the animal being about 25 feet.

Fig. 2, *Hadrosaurus mirabilis* (Leidy), a huge Dinosaur 38 feet in length, with a head like an *Ornithorhynchus*, with small fore-limbs and heavy hind-limbs and tail. Like *Triceratops* it was found in the Laramie Cretaceous beds. *Hadrosaurus* was probably of amphibious habits, feeding on soft water-plants or small mud-loving organisms. Its body was covered with a thick rhinoceros-like hide, parts of which were found preserved with the skeleton in Prof. Cope's specimen.

Fig. 3, *Megalosaurus?* (*Lælaps*, *Dryptosaurus*), *aquilunguis* (Cope). A carnivorous type of Dinosaur, about 15 feet in length, 8 feet of which was represented by its tail; light and agile in form, and armed with powerful teeth and claws. The disproportionately long hind-limbs and heavy tail remind one of the kangaroo, which it may also have resembled in its mode of progression, by leaps instead of walking or running. It probably used its powerful hind feet armed with heavy claws in attacking its enemies. The jumping powers, as represented in the model of two fighting *Lælaps*, was suggested by Prof. Cope. *Lælaps* was first described by Cope from the Cretaceous beds of New Jersey. The name (*Lælaps*) being preoccupied, Prof. Marsh substituted that of *Dryptosaurus;* but in order to avoid the use of this name, it is here suggested to place it in Buckland's genus *Megalosaurus!*

Fig. 4, *Nanosaurus claviger* (Cope) is from the Permian beds of Texas, and is a highly-specialised form belonging to the primitive reptilian order *Pelycosauria* of Cope, and to the sub-order *Rhynchocephalia*, "beak-headed" reptiles. As to the precise object of the extraordinary rigid fin-like crest upon the back, it is not easy to conjecture. Prof. Cope humorously suggested that it might have been used as a sail. Again, it might have asisted the creature in swimming, or was perhaps only ornamental. It was supported upon enormously elongated ladder-like processes of the dorsal vertebræ, a structure probably unique amongst the Reptilia or even amongst Vertebrates.



No. 1. Agathaumus sphenocerus *Cope.*

No. 2. Hadrosaurus mirabilis *Leidy.*

No. 4. Nanosaurus claviger *Cope.*

The last model is that of *Cervalces americanus*, a Pleistocene form of the American elk, which was of the same size and proportions as the living moose, but had horns almost as large as those of the extinct gigantic Irish deer, expanded in three planes of growth nearly at right angles to each other. The model is based upon

a remarkably perfect skeleton found in New Jersey, and mounted in the Princeton University Museum. Prof. Scott, who described it in 1885, suggested that it possessed characters intermediate between those of the deer and moose.

The other casts executed embrace the fore and hind foot of *Coryphodon radians*; the fore-foot of *Palæosyops paludosus*; the front of skull and lower jaw of *Diplacodon*

No. 3. Megalosaurus (Lælaps, Dryptosaurus) aquilunguis (*Cope*).

marginatus; the lower jaw of *Dromatherium sylvestre*, described by Emmons from the Trias of North Carolina in 1854; the lower jaw of *Microconodon tenuirostris*; and the brain-casts of *Periptychus rhabdodon*, and of *Pantolambda*.

Interesting as are these casts, we venture to think that the most valuable work achieved by Mr. Osborn is the production of the fine series of photographs (bromide enlargements from the original negatives, size 18 inches × 22 inches).

These excellent pictures, of which a number may be seen mounted and exhibited in the galleries of the British Museum (Natural History), Cromwell Road, London, consist (1) of photographs of eleven mounted skeletons of rare fossil mammals, as *Metamynodon*, *Titanotherium*, *Hyrachyus*, *Patriofelis*, *Protohippus*, *Hoplophoneus*, *Palæosyops*, *Phenacodus*, *Coryphodon*, *Teleoceras*, and *Acera-therium*; and (2) photographic restorations, of the same size as the skeletons, depicting the animals clothed in their flesh, and represented in different attitudes according to their known habits and surroundings.

They are taken from a series of large water-colour drawings executed by Mr. Charles Knight, the animal painter, with the object of increasing the popular interest in these extinct animals, and to give a fuller and truer idea of their anatomy and external form than is afforded by the skeleton alone. The position of all the joints and angles of the feet and limbs is true to life, being governed by the skeleton itself. The lips, nostrils, and gape of the mouth are determined by comparison of the length of the nasals, size of the interior nares, character and position of the teeth, with similar parts in the remotely-related living forms. The eyes are carefully located and proportioned. Up to this point the animal is a fairly correct representation of the original. On the other hand the shape of the ears, the colour and epidermic characters of hair and hide are largely imaginative, except in so far as they are suggested by relationship to modern allies, as of *Protorohippus* to the horse, or of *Acera-therium*, *Metamynodon*, and *Hyracodon* to the rhinoceros. (The price of these photographs is fixed at four dollars each).

These restorations include *Patriofelis*, an aquatic Middle Eocene carnivore with broad flat plantigrade feet with spreading toes, well adapted for swimming. He was not, perhaps, as expert a swimmer as the seals are now, but was sufficiently active in the water to capture turtles.

This is, perhaps, the least original and successful of the restorations, being modelled somewhat too closely upon the existing otter.

The second restoration is that of the little four-toed Lower Eocene horse (*Protorohippus venticolus*). This animal in life was about four hands or sixteen inches in height at the withers. The mane is left upright; the forequarters and neck are striped. The body is, perhaps, too large for such very slender and graceful legs.

The third restoration is based on a study of the mounted skeleton of the *Aceratherium*, a hornless form of rhinoceros from the Upper Oligocene formation.

The next picture represents the six-horned *Protoceras*, a Tertiary ruminant from South Dakota, not unlike the North American prong-horn antelope, with soft snout and fleshy upper lip as in the modern saiga.

Metamynodon, an aquatic hornless rhinoceros from the same deposits, affords the subject for a fifth cartoon. The giant pig (*Elotherium*), from South Dakota lake deposits, forms a sixth illustration. The head in the male is of enormous size, but the chest is small and the limbs are extremely tall and stilted. The great projecting flanges below the cheeks, for the attachment of the masseter muscles, presented peculiar difficulties to the artist to represent correctly.

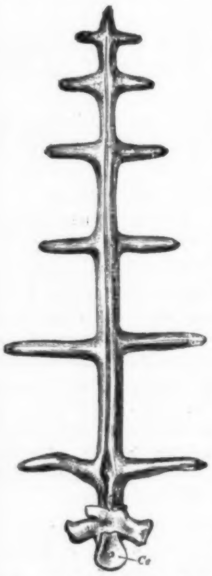


FIG. 5.—Anterior view of a single dorsal vertebra of *Nanosaurus claviger* (nat. size), Cope. Permian, Texas (*Ce*, centrum).

Another striking group is that of the Titanothere, a huge horned pachyderm, of which the male, female and young are depicted. There is no doubt that the females were smaller, and possessed imperfectly-developed horns and narrow zygomatic arches; the males had a pair of extremely long recurved horns, placed transversely on the nasals. In the general structure of the skull, as well as in its dentition, *Titanotherium* (except in the peculiar position of the horns) suggests the modern rhinoceros.

The most striking of these large early Tertiary mammals is undoubtedly the *Uintatherium*, of which Mr. Knight has made an excellent picture. There are quite a number of species of this huge many-horned ungulate, for which the sub-order Dinocerata was proposed by Prof. O. C. Marsh, and on which that author founded an admirable quarto monograph in 1884. Like many American forms it enjoys several generic names, as *Dinoceras*, *Tinoceras*, and *Uintatherium;* the last, being that proposed by Prof. Leidy in 1872, has no doubt the strongest claim to priority.

Three pairs of bony, rounded horn-like protuberances mark the skull; the tusks, which are large, are thought to have been used to draw the branches and leaves of shrubs into the mouth; the skeleton at once suggests that of the elephant, and presupposes a similar hide. A papier maché (life-size) restoration of the skeleton of *Uintatherium* (*Tinoceras*) *ingens*, presented by Prof. O. C. Marsh, in addition to Mr. Knight's restoration of *U. cornutum*, grace the Natural History Museum in Cromwell Road.

To these we may add the restoration of *Hyracodon*, a small running form of rhinoceros of as light a build as a modern zebra, but lacking its grace of head.

The tenth restoration is that of a large carnivore *Mesonyx*, which, from the blunted condition of its teeth, suggests that the animal was omnivorous in diet, and that it might have lived partly upon turtles or decaying animal food. The body is represented as large and the legs very short, and therefore not well adapted for the pursuit of living prey.

Palæosyops, a Middle Eocene Titanothere resembling the tapir in habits, with an elongated prehensile upper lip and slender fore-feet, is believed to have inhabited the low marshy lands, feeding entirely upon the softer kinds of leaves and grasses, since its teeth are unadapted to hard vegetable food.

The last restoration is that of the *Mastodon*, which, being so much akin to the elephants of to-day, affords little scope for the imagination in depicting him as a living animal.

The feet are larger and more projecting than in the existing species of elephants, the limbs are relatively shorter, and the head has the low flat skull of the African rather than the high prominent forehead of the Indian elephant.

We cannot fail to congratulate Prof. Osborn on the work upon which he is engaged, and to express the hope that many more of these restorations may be evolved from the fertile invention of the artist, tempered by the careful and chastening influence of the comparative anatomists of the American Museum of Natural History, New York.

JOHN A. R. NEWLANDS.

WE regret to have to record the death of Mr. John Newlands, as a consequence of an attack of influenza, at the comparatively early age of sixty-one. While probably no subject in the whole range of theoretical chemistry has received a greater amount of attention than the numerical relations among the atomic weights of the elements, few among the younger generations of chemists are acquainted with the circumstances attending the establishment of the remarkable generalisation usually known as the "Periodic Law." The contemporaries of Newlands, however, and all who have taken the trouble to look into the literature of the subject, know that it was he who discovered the fundamental relation embodied in this so-called law, and that he clearly expressed the connection between atomic weight and properties about five years before any publication of their views either by Mendeléef or Lothar Meyer. Fortunately the facts stand out from the records clearly enough, but it is difficult now, after a lapse of more than thirty years, to explain the indifference of the chemical world to an observation so remarkable as that to which Newlands drew attention first in the *Chemical News*, August 1864, again more fully in the same journal, August 1865, and a third time more emphatically in a communication to the Chemical Society, March 9, 1866. For many years previously the subject had been, so to speak, in the air. Numerous papers by Dumas, Gladstone, and latterly by Odling, had appeared in which various arrangements of the atomic weights had been adopted, but none of a comprehensive kind; yet when a scheme which consisted not of a number of isolated groups, but which supplied a system covering the whole of the known elements, was brought forward, all that the Chemical Society could do was to reject it with ridicule and contempt, and to decline to print a word of the new doctrine in the then scanty pages of its *Journal*. The unsettled state of opinion in reference to the numerical values of many atomic weights can be the only excuse for what seems like stupidity and prejudice, for Newlands' arrangement required the adoption of the atomic weights standardised as recommended by Cannizzaro in 1864-66, and these values were still unknown to, or ignored by many chemists. Newlands called his scheme the "Law of Octaves," and he showed

that the fifty-six well-established elements which he was able to consider, when arranged in the order of the magnitudes of their atomic weights, formed eight octaves, each eighth element exhibiting a recurrence of the same or closely similar chemical and physical properties. All this is now acknowledged, but the Chemical Society never did Newlands full justice in the matter; and while the Royal Society awarded the Davy Medal jointly to Profs. Mendeléef and Lothar Meyer for their work on the periodic scheme, it was only some years later, namely in 1887, that the same distinction was conferred, we believe in consequence of Dr. Frankland's representations, upon the discoverer of the law.

They order these things better in France. If Newlands had been a Frenchman, the Academy of Sciences and the Chemical Society, even if they had at first fallen into error, would have taken care that in the distribution of honours their own countryman should not come in last.

John Alexander Reina Newlands, to give him his full name, was the second son of the Rev. William Newlands, M.A. Glasgow, a minister of the Established Church of Scotland, and was born in Southwark in 1837. He was educated privately by his father, and, having early imbibed a taste for chemistry, he entered the Royal College of Chemistry as a student under Hofmann, in October 1856. After a year at College he became assistant to Prof. Way, then chemist to the Royal Agricultural Society. His mother, though born in England, belonged to an Italian family, and the insurrectionary movement under Garibaldi roused the enthusiasm and sympathy of the young chemist to such a pitch that, on the call for volunteers in 1860, he left Way, and went to fight in the cause of Italian freedom, and only returned home at the end of the campaign. He then rejoined Way for a time till, in 1864, he began practice on his own account as analytical chemist in the City. About this time, and for some years later, he taught chemistry at the Grammar School of St. Saviour's, Southwark, at the School of Medicine for Women, and at the City of London College. In 1868 he became chief chemist at Mr. James Duncan's extensive sugar refinery at the Victoria Docks, and remained in that position till 1886, when, in consequence of the decline of the business owing to foreign competition, he joined his brother, Mr. B. E. R. Newlands, in independent practice as analytical and consulting chemists. Mr. Newlands' name was associated with the invention of several important improvements in the refining of sugar, especially, we believe, the so-called alum process for the purification of beet molasses.

In 1884 Mr. Newlands published a small volume containing a reprint of all his papers on atomic weights, with some additions embodying his later views on the same subject. He is also author, jointly with his brother, of a treatise on "Sugar, a Handbook for Sugar Growers and Refiners," and of some articles on "Sugar" in Thorpe's Dictionary.

Mr. Newlands left a widow, a daughter, and a son, Mr. W. P. R. Newlands. The latter studied chemistry at the Royal College of Science, and will take his father's place in the firm.

A kindly courteous man, his face will be much missed by the older Fellows of the Chemical Society, where he had been a familiar figure for so many years.

W. A. T.

PROFESSOR GEORGE EBERS.

PROF. EBERS, the well-known Egyptologist, whose death has recently been announced, will be long remembered in connection with the papyrus which bears his name. Dr. Ebers was born in 1837 at Berlin, and his friendship with Brugsch and Lepsius led him to take a keen interest in Egyptology. In pursuit of his studies he visited Egypt, and it was during the winter of 1872-73, while staying at Thebes, that he had the good fortune to purchase from a native dealer at Luxor the hieratic medical papyrus which made him famous. On his return from Egypt he deposited the papyrus in the University Library at Leipzig, and two years later he published a facsimile of the text, with a description, glossary, &c., in collaboration with his friend Dr. Ludwig Stern. The "Papyrus Ebers," which is in a perfect state of preservation, is the most important medical papyrus that has been found in Egypt, and has thrown considerable light on the medical knowledge of the ancient Egyptians. In addition to his numerous publications on Egyptian archæology, Dr. Ebers gained a considerable reputation as a novelist. In 1889 ill health compelled Dr. Ebers to relinquish his duties as Professor of Egyptology at Leipzig, and from that time till his death he was a confirmed invalid.

NOTES.

THE death is announced of M. N. A. Pomel, of Algiers, Correspondant of the Section of Mineralogy of the Paris Academy of Sciences.

THE Paris Academy of Medicine has received information that a legacy of fifty thousand francs has been bequeathed to it by Mme. C. E. Bragayract.

DR. EVERT JULIUS BONSDORFF, formerly Professor of Anatomy and Physiology in the University of Helsingfors, has just died at the age of eighty-eight years.

M. BROUARDEL will be the president of the French Association for the Advancement of Science, at the meeting to be held next year at Boulogne. General Sébert has been elected vice-president of the Association, and will succeed to the presidency in 1900, when the meeting will take place in Paris.

A REUTER telegram from Naples announces that Mount Vesuvius is in a state of active eruption. The lava is flowing in four streams, its progress being at the rate of 100 yards an hour. The chestnuts on Mount Somma have been burned. Constant explosions are heard from the central crater, which is throwing out volcanic ash, and giving other evidence of activity.

A CONGRESS of the Astronomische Gesellschaft will be opened at the Academy of Sciences at Budapest on September 24. Meetings will also be held on Monday and Tuesday, September 26 and 27. The Hungarian members of the Society have prepared a cordial reception for the astronomers who attend the Congress, among the hospitable features being a luncheon to be given by the Minister of Public Instruction (Dr. Julius von Wlassitz), a dinner by the town of Budapest, visits to places of interest in the town and neighbourhood, and excursions to the O'Gyalla Observatory and the Danube Cataracts—the Iron Doors. The Congress will certainly give a prominent place to the discussion of questions concerning the international zone-catalogue of the Astronomische Gesellschaft; and the resolutions of the Paris Conference, which have given rise to a large amount of criticism, will also be dealt with. Prof. F. Porro will present a preliminary report on the revision of the Piazzi Catalogue of Stars, undertaken by Dr. H. S. Davis and himself.

A COMMITTEE, having upon it many distinguished men of science in Australia, has been formed to secure the establishment of some permanent memorial to commemorate the services rendered by the late Baron von Mueller. This movement is entirely distinct from that which the executors of the late Baron have initiated with the object of obtaining funds for the erection of a tombstone. The object of the Committee of the National Memorial Fund is to secure sufficient funds to allow of

the establishment of some permanent memorial which shall worthily perpetuate Baron von Mueller's name; and whilst it is not possible as yet to state definitely the form which the memorial will take, it is hoped that sufficient funds will be forthcoming to provide for (1) the erection of some form of statue, and (2) the endowment of a medal, prize or scholarship, to be associated with Baron von Mueller's name, and to be awarded from time to time in recognition of distinguished work in the special branches in which he was most deeply interested, and which shall be open to workers throughout the Australasian Colonies. Subscriptions to the fund may be sent to the Hon. Treasurer, addressed to the College of Pharmacy, Swanston Street, Melbourne, or to the Hon. Secretaries (Mr. W. Wiesbaden and Prof. Baldwin Spencer), addressed to the University of Melbourne, and will be duly acknowledged.

Science states that Prof. Simon Newcomb will next year resume the active superintendence of the work in mathematics and astronomy in Johns Hopkins University. He expects to give a course of lectures on the Encyclopædia of the Mathematical Sciences, and will especially direct students pursuing advanced work in celestial mechanics.

THE Antarctic expedition, equipped and sent out by Sir George Newnes, sailed from London in the *Southern Cross* on Monday. Mr. Borchgrevink is in charge of the expedition, and with him are Lieut. Colbeck, Mr. Bernacchi, Mr. Hanson Nicolai, Dr. Sharp and Mr. H. B. Evans, all of whom will carry on scientific studies in the Antarctic regions. There are thirty-three men on board, all told. The ship, which has been built with the special object of Antarctic exploration, is barque-rigged, and is a modified form of the *Fram*. If all goes well, she may be expected to return in the year 1900.

THE Berlin correspondent of the *Times* states that the German Polar expedition which in the spring of this year started, under the direction of Herr Theodor Lerner, with the object of defining more closely the topography of the Polar regions and, if possible, of discovering some traces of the Andrée expedition, has just returned to Hammerfest, where a short stay will be made in order to allow the ship *Helgoland* to be refitted and the crew to take a temporary rest. The following particulars of observations made during the voyage have been published:—King Charles Islands were reached towards the end of July, and a halt of a few days was made. Observations there made show that the group consists of three big islands—namely, Swedish Foreland, Jena Island, and a third lying between these two, which has been christened August Scherl Island in honour of the promoter of the expedition. There the explorers came upon the breeding grounds of the ivory gull, very few specimens of whose eggs have hitherto been discovered. Two small islands in the southern bay of Jena Island received the names of Tirpitz and Helgoland respectively. Captain Rüdiger took special observations of the exact position of King Charles Islands. An attempt to push on to Franz Josef Land failed owing to bad weather. The *Helgoland* then was able to coast round the island on the north-east and from the south, in spite of the difficulties caused by fog and ice, thereby proving that it is possible to go northwards notwithstanding the contrary Polar currents. The exact position of the island of Störö is given as being 10′ further north than it is at present indicated in maps. The most northerly point reached was latitude 81° 32′, where the boundary of pack ice was determined. Much hitherto unknown ground was fished with drag nets, especially round the east point of King Charles Islands, and at the extreme end of Spitsbergen in water of over 1000 metres deep. A good deal of interesting material for future study was obtained. No signs of the Andrée expedition were discovered. The expedition will start on another voyage of exploration as soon as the ship has been refitted and the necessary stock of victuals been taken on board.

THE journey to Tomsk, in Siberia, promises to become quite a pleasant one under the new organisation of the direct trains. The train, which left St. Petersburg on July 31, offered even more comforts to the travellers than the best American trains. It consisted of one first class and two second class sleeping cars, one dining car, and one kitchen and electrical machinery car. It had also, in addition to the usual luxurious fittings of the best Pulman saloon cars, a piano in the first class saloon, a free library provided with a good selection of works on Siberia, as well as with all the papers which appear in the towns passed by the train during the journey; a pretty outlook-saloon at the back of the train, with meteorological instruments in it; and even a dark room for amateur photographers, arranged in the second class lavatory. All the furniture is covered with a special material which can be washed with a disinfecting fluid without being injured.

THE annual Congress of the Royal Institute of Public Health was opened on Thursday last in Dublin. There was a very large and representative gathering of delegates, including the Lord Mayor of Dublin and the Mayors of many towns in England and Ireland. The President, Sir C. Cameron, Medical Officer of Health for Dublin, delivered an inaugural address, in which he dealt chiefly with the improvements effected within the past thirty years in urban sanitation, the most important of which he described, pointing out the extent to which they had affected the death-rate in London, Dublin, and other urban centres of the United Kingdom. The members of the Congress were subsequently present at the formal opening, by the Lord Lieutenant, of the usual Health Exhibition in connection with the Congress. The sectional sittings began on Friday, and a large number of papers, covering a wide range of subjects concerning public health, were read and discussed. On Saturday afternoon a special meeting of the Fellows of the Royal College of Physicians of Ireland was held for the purpose of conferring the honorary Fellowships in connection with the Congress, and the occasion was also taken advantage of to confer honorary diplomas in State Medicine conjointly with the Royal College of Surgeons in Ireland. The following are the names of those on whom the honours were conferred:—Honorary Fellowships: Dr. Alexander Crum Brown, F.R.S.; Sir Charles Cameron; Dr. Mathew Hay; and Sir Richard Thorne Thorne, K.C.B., F.R.S. Honorary Diploma in State Medicine: Dr. T. W. Grimshaw, C.B.; Sir Henry Littlejohn; Dr. John W. Moore; Dr. W. R. Smith; Dr. T. J. Stafford; and Dr. J. C. Thresh.

THE spell of hot weather which set in over the southern portion of our islands about a fortnight ago has continued without interruption, and at the beginning of the present week the heat was even greater than previously. The London reporting station of the Meteorological Office gave 89° as the shade temperature on Monday, and in parts of the southern suburbs the thermometer touched 90°. There have already been at least ten days in the neighbourhood of London with a temperature of 80° and above, and on nine nights already the thermometer has not registered a lower reading than 60°. The warm nights are quite phenomenal, and the Greenwich orbservations for the previous twenty Augusts only show, in all, eleven such warm nights. The weather has for the most part been much cooler over the northern portion of our islands than in the south. Fog or mist has been very prevalent on ou coasts, and this has occasioned much delay and inconvenience

to shipping. Thunderstorms have occurred in the western and central districts of England, and lightning has occurred over nearly the whole kingdom. Very little rain has fallen, except in a few isolated parts, where the thunderstorms have yielded a fair amount.

THE British Pharmaceutical Conference, which opened at Belfast on August 9, was a very successful meeting at which the science of pharmacy was well represented, and many papers of high merit were communicated. The presidential address, delivered by Dr. Charles Symes, was a comprehensive survey of affairs and advances in which pharmacists are interested. Synthetic compounds used in medicine and for various industrial purposes were described, the president pointing to the ever-growing lists of physiologically active synthetic organic compounds as evidence for the necessity for pharmacists to keep up with the developments of modern chemistry. Many of these compounds, which have been built up on theoretical considerations, have become valuable medicinal remedies. The fancy names given to them, however, rarely afford any definite idea of their composition, and without this pharmacists handle them in a very mechanical way, and lose much of interest that would otherwise attend the dealing with them. Dr. Symes expressed the hope that pharmacists would familiarise themselves as far as possible with the numerous class of substances which he had mentioned, for although they are of a complex nature, they are capable of much simplification by a consideration of the theoretical constitutions ascribed to them. Mr. Hodgkin read a paper on this subject at a meeting of the Conference held at Leeds in 1890. More recently Dr. Kohn, in an address delivered at a meeting of the Liverpool section of the Society of Chemical Industry, dealt with the relation which exists between the physiological action and the chemical structure of these bodies. The scientific chemist, remarked Dr. Symes, is now the architect and builder, using certain atoms and molecules to build up chemical structures to meet the wants of the medical profession in the treatment of disease. In Germany, where there are fewer restrictions on experimenting with animals than in this country, the chemist and physiologist work together—the one altering the molecules and molecular arrangement in the chemical, and the other testing and noting most carefully the effects obtained thereby; hence most of these remedies are produced in that country, and this manufacture has become an extensive chemical industry. Since the publication of Mr. Hodgkin's paper, referred to above, many new synthetic remedies have been introduced, and Dr. Symes gave a list of some of them, pointing out that of the fifty substances enumerated, a large percentage possess antiseptic, antipyritic, and analgesic properties; so that their rapid growth would seem to be due more to commercial enterprise than to meeting a real want in medical practice.

ANOTHER chemical industry, which has considerable interest for the pharmacist, was referred to by Dr. Symes at the Pharmaceutical Conference; it is the production of synthetic esters and odorous substances closely related to the odours of flowers, plants, and animal substances. With artificial musk and vanillin pharmacists have been long familiar, as also with the amyl, butyl, and ethyl compounds resembling fruit flavours, but of more recent date they have heliotropine (heliotrope), ionone and iraldine (violet), cumarine (new-mown hay), terpineol (lilac), bergamiol or linaloyl acetate (bergamotte), nerolin (neroly), jasmin oil, anisic aldehyde (hawthorn), geranol (rose geranium), carvol (caraway oil), safrol (oil of sassafras), &c. So much has this industry grown that not only are these products used for toilet soaps, but they also enter largely into the composition of the essences named after the flowers. They are more persistent than the natural odours, and it is said that the very popular essence of "Parma Violets" is, as a rule, quite innocent of the flowers, and is prepared from ionone mellowed down with small quantities of other extracts; and this the public really prefer. To those, however, who are accustomed to handle delicate perfumes, there is not so much difficulty in distinguishing between the artificial and the real, and it still taxes the skill of the chemist and the art of the perfumer to obtain that subtle delicacy of fragrance manufactured and elaborated in nature's own laboratory.

AN observation recorded by Mr. B. B. Osmaston in the *Journal* of the Asiatic Society of Bengal (vol. lxvi. Part 2, No. 4) indicates that, in some birds at least, the social instinct is present in a highly developed form. A young "Shikra," the Indian Sparrow-Hawk (*Astur badius*) trained to catch Mynahs and other birds, was sent after a party of "seven sisters" (the Jungle Babbler, *Crateropus canorus*) feeding on the ground. The Shikra captured one after a short chase, but the rest of the Babblers, however, hearing the cries of their captured "sister," came down to the rescue without the slightest show of hesitation, and in a short time were engaged in a spirited attack on the Hawk, apparently using both beak and claws in their effort to make her relinquish her hold, which she eventually did. Mr. Osmaston says that he has many times flown a Shikra at *C. canorus* always with the same result, viz. that so long as he kept out of the way the Babblers would attack the Hawk *en masse*.

THE article upon William Turner, the "Father of British Zoology," contributed by the Rev. H. A. Macpherson to the August number of the *Zoologist*, appears at an opportune time, for it draws attention to the important part which Cambridge, where the International Zoological Congress is now in progress, played in training the first naturalists bred upon English soil. Turner was born about 1507, took his degree at Cambridge in 1529–30, and was elected a Fellow of Pembroke Hall in the latter year. He spent the next ten years of his life as a Cambridge don, and during that time acquired an intimate knowledge of the habits of British wildfowl by personal observation. He did not, however, confine his field work to the neighbourhood. In 1542 he went abroad, and became acquainted with the habits of birds which he had never met in England. Turner travelled in Italy, and attended the botanical lectures of Lucas Ghinus at Bologna before he journeyed to Zürich, the home of Conrad Gesner, who alludes to him in terms of sincere admiration. On quitting Zürich, we learn from Mr. Macpherson's article, the English traveller journeyed to Basle, and thence to Cologne. During his residence in the latter city, in 1544, he printed the first ornithological work that the New Learning was destined to produce. Turner was still comparatively young, probably on the right side of forty, but his scholarly taste had already induced him to apply his critical skill to the difficult task of determining the particular species of birds described by Aristotle and Pliny. Accordingly, he entitled his little book, "Avium præcipuarum quarum apud Plinium et Aristotelem mentio est, brevis et succincta historia ex optimis quibusque scriptoribus contexta." Trifling as this may appear beside the ponderous tomes of Gesner and Aldrovandus, the fact remains that it forms a very important contribution to the science of the sixteenth century. Turner did not confine his attention to ornithology; he was also keenly interested in the fish fauna of these islands. His Catalogue of British Fishes, compiled when residing in Wissenburg in 1557, was a remarkable production for the middle of the sixteenth century. His Herbal was completed in 1568, and on July 7 of that year the great naturalist quietly passed away.

THE *Electrical Review* gives particulars of the experiments in telegraphy without intervening wires, which have been made

during the past few weeks by the Wireless Telegraph Company, between the Royal yacht *Osborne* and Osborne House. Perfect signals are stated to have passed both ways during the whole ten days of the trials, no hitch occurring from first to last. Numerous messages passed between the Queen and the Prince of Wales, and between the Prince and a number of other members of the Royal family, and one or two Cabinet Ministers. Mr. Marconi had charge of the trials. Every morning a bulletin on the condition of the Prince was sent to the Queen by wireless telegraph. The height of the mast on shore was 105 feet, and that of the top of the wire from the deck of the *Osborne* was 83 feet. The yacht was moored in Cowes Bay, at a distance of nearly two miles from Osborne House, the two positions not being in sight of one another, as they were intercepted by a hill to the rear of East Cowes, which would have rendered signalling impossible between these two stations by means of any optical system. The messages varied in length, some having as many as 100 to 150 words. Towards the end of the period over which the experiments extended, the yacht went on a cruise towards Sandown, and the messages were received correctly close off the *Nab* lightship, which is moored off Bembridge. On the way there, when under steam, a lengthy message was received by the Prince from the Duke of Connaught, and the reply was successfully despatched, though well out of sight of Cowes and Osborne. Upon another occasion the yacht cruised as far as the Needles, or rather outside, and went on till the instruments picked up Alum Bay station—the Needles Hotel—continuing in communication with them all the way. Communication was kept up throughout the cruise with either the Osborne station or the Wireless Telegraph Company's station at Alum Bay. During the whole of the cruise the Osborne pole was obscured, and all the messages had to pass overland, and the Alum Bay pole was also obscured until coming right into the Bay, on account of the station being situated very much below Heatherwood. The messages were sent to Alum Bay from a distance of nearly seven and a half miles, although the ground lying between was exceedingly high; in fact, it was about the highest land met with during the time. It was so high, that the poles were screened by hundreds of feet of land.

HERR EDUARD ZACHE contributes a short article to the *Naturwissenschaftliche Wochenschrift*, on the identification of tectonic structures in the Mark region in Prussia. The problem is one of some difficulty in all parts of the North German Plain, on account of the uniformity of the diluvial covering. The results of the examination are exhibited in a sketch-map.

THE *Revue Générale des Sciences* (No. 13) contains a valuable paper by M. J. Machat, on the scientific basis of the Chinese Question. The physical and economic geography of China is sketched under the headings of soil, climatic conditions in relation to vegetation, animal life, and hydrography, agriculture, industries, internal commerce, demography, and foreign commerce. A series of extremely interesting maps illustrates these sections.

WE have received a reprint of a paper read at the Toronto meeting of the British Association by Mr. J. B. Tyrrell, on the glaciation of North Central Canada. The conditions supposed to prevail during the existence of the great central continental ice-sheet—or, as it is now called, the Keewatin glacier—are described, and its life-history is traced as far as possible. The glacier appears to have been similar in character to the great glacier of north-western Europe, but with the difference that while the centre of the latter was over a high rocky country from which the ice naturally flowed outwards, the centre of the former was over what was probably then, as now, a low-lying plain.

IN order to make known the scientific value of the collections in the South African Museum and the original work done by the staff, as well as to promote the increase of the library by means of exchange with museums and scientific societies, the Trustees have commenced a serial publication entitled "The Annals of the South African Museum." The first part of this addition to scientific serials contains descriptions of new South African Scorpions in the collection of the South African Museum, by Dr. W. F. Purcell; description of some Mutillidæ in the Museum, by Mr. L. Péringuey; list of the reptiles and batrachians of South Africa, by Mr. W. L. Sclater; and a catalogue of the South African Hispinæ (Coleoptera), by Mr. Péringuey.

DR. FRIEDRICH KATZER contributes to *Globus* a paper on the volume of the Amazon at Obydos. Below Obydos the Amazon flows through so many channels that accurate measurements of its total discharge are impossible, and even there—900 kilometres from the mouth—a considerable fraction of its waters does not pass through the main channel. Dr. Katzer discusses former measurements, and gives new ones of his own; he finds as mean values—breadth, 1890 metres; rate of current, 1·2 metres per second; discharge, 120,000 cubic metres per second. Analyses of two samples of water, taken at depths of 0·5 metres and 25 mètres, gave 0·056 and 0·039 grammes per litre as total dissolved matter; suspended matter, three to four times as much; thus placing the Amazon amongst the purest river-waters of the globe.

IT is reported in the *Times* that MM. Dex and Dibos, two French aeronauts, who recently submitted their scheme for the exploration of Africa by means of a balloon to the French Academy and the Smithsonian Institution, which bodies are stated to have approved of the plans, have now, in conjunction with M. Hourst, the African traveller, invoked the aid of the Paris Municipality in support of the great undertaking. They do not profess to be able—and in this they are in accord with workers in the same direction—to construct a completely dirigible balloon; but they believe in the practicability of their scheme, assuming the air currents of tropical Africa are fairly regular, at least at certain seasons. The balloon they intend to construct is to be 92 feet in diameter, with a capacity of 406,134 cubic feet. It is to be made of silk, and covered with an eight-fold coat of varnish, so that only a very small quantity of gas will be lost per day. The car will be in two storeys, connected by a rope ladder, the upper storey providing living and sleeping accommodation for six travellers, the lower being reserved for the apparatus used in manœuvring the balloon. Another smaller car, anchored to the balloon, is to serve as a means of communication with *terra firma*, and to be lowered when the balloon has been anchored. The sum of 15,000 francs, for which the Paris Municipality has been asked, is intended for preliminary trials, as the cost of the actual journey through Africa, it is hoped, will be defrayed by rich members of the Committee for French Africa. M. Dex describes the scheme in the current number of the *Revue Scientifique*.

THE U.S. Pilot Chart of the North Atlantic Ocean for August contains a type of the summer chart of that ocean, representing the conditions of wind, cloud and barometric pressure, compiled from Greenwich noon reports returned to the Hydrographic Office at Washington. The chart shows very clearly the right-handed or clock-wise circulation of the winds around the region of high barometric pressure, the central area of which, at this season of the year, is in the region of the Azores. Another special chart shows the drifts of floating bottle-papers returned to the Hydrographic Office during the year ending July 1 last, and referring to the Atlantic Ocean. Some of the present papers offer interesting particulars; one, which

was cast adrift off Nantucket Shoal, and recovered near Campbelton after the lapse of 512 days, giving an average daily velocity of 5·1 miles. Three other bottles, which were thrown overboard in mid-ocean at the same time, were all recovered within a short distance of each other in the same week after a drift eastward of 1200 miles, the mean rate of travel being 9·9 miles a day.

Two sphygmograph curves, obtained by Mr. R. De C. Ward at altitudes of 15,700 feet and 19,200 feet, are reproduced in a short paper in the *Journal* of the Boston Society of Medical Sciences (June). The curves derive interest from the fact that they are the first from so great altitudes to be reproduced, and also because the peculiarities of heart action shown in them are the result of altitude pure and simple, as absolutely no physical was taken in making the ascents.

IN the current number of the *Zeitschrift für physikalische Chemie*, Mr. S. L. Bigelow describes some interesting results of experiments made in Prof. Ostwald's laboratory on the catalytic action of organic substances on the oxidation of sodium sulphite. It has been known for a considerable time that the rate of oxidation of sulphurous acid is increased by the presence of many inorganic salts. In beginning a closer investigation of this subject, Mr. Bigelow was accidentally led to the discovery that the oxidation of a sodium sulphate solution by a current of air is hindered to a remarkable extent by the presence of a small quantity of alcohol. One part of alcohol in ten thousand of a one-hundredth normal solution of sodium sulphite had a perceptible influence. In another case it was found that the admixture of mannitol with sodium sulphite in the proportion of one molecule to eight hundred, diminished the rate of oxidation 50 per cent. Great difficulty was experienced in obtaining constant results, and it was found that the small quantities of impurity in the water used as solvent, and in the aspirated air, produced large variations: it was, in fact, not found possible to obtain perfectly constant conditions. An extension of the inquiry to other organic substances led to the discovery of some regularities, but not to the establishment of any general theory of the action. The phenomenon obviously bears some relation to the well-known inhibitory action of organic substances on the oxidation of phosphorus.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus sinicus*, ♂) from India, presented by Miss E. Sandell; a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Madam Giorgi; a Rhesus Monkey (*Macacus rhesus*) from India, presented by Miss Leathers; a Sykes' Monkey (*Cercopithecus albigularis*, ♀) from East Africa, presented by Mr. C. Carter; a Grand Eclectes (*Eclectus roratus*) from Molluccas, presented by Mrs. Peter Watson; a Corai's Snake (*Caluber corais*) from British Guiana, presented by Mr. C. W. Lilley; a Chimpanzee (*Anthropopithecus troglodytes*, ♀) from West Africa, a Tiger (*Felis tigris*) from Eastern Asia, a Leopard (*Felis pardus*) from Africa, a Red-bellied Wallaby (*Macropus billardieri*) from Tasmania, two Elephantine Tortoises (*Testudo elephantina*) from Aldabra and Mahe Islands, a Reticulated Python (*Python reticulatus*) from the East Indies, deposited; two Maximilian's Aracaris (*Pteroglossus uredi*), three Lettered Aracaris (*Pteroglossus inscriptus*), six Superb Tanagers (*Calliste fastuosa*), four Brazilian Hangnests (*Icterus jamaicai*), three Merrem's Snakes (*Rhachnæa mirrimi*) from Brazil, two Red Under-winged Doves (*Leptoptila rufaxilla*), a Little Guan (*Ortalis motmot*) from Guiana, three Golden-headed Conures (*Conurus aureus*) from South-east Brazil, two Red-ground Doves (*Geotrygon montana*) from South America, purchased; a Burrhel Wild Sheep (*Ovis burrhel*), born in the Gardens; six Californian Quails (*Callipepla californica*), a Crested Pigeon (*Ocyphaps lophotes*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

COMET PERRINE (MARCH 19).—Dr. Berberich communicates to *Ast. Nach.* (3510) the following elliptical elements for Comet I. 1898 (Perrine, March 19):—

$$T = 1898 \text{ March } 17{\cdot}11244 \text{ Berlin M.T.}$$

$$\left.\begin{aligned} \omega &= 47^\circ\ 15'\ 4''{\cdot}0 \\ \Omega &= 262\ 24\ 37{\cdot}1 \\ i &= 72\ 32\ 45{\cdot}2 \end{aligned}\right\} 1898{\cdot}0$$

$$\log q = 0{\cdot}040842$$
$$\log e = 9{\cdot}9897755$$
$$\text{Period} = 322{\cdot}56 \text{ years.}$$

An ephemeris for Berlin midnight, computed from these elements, is also given; but seeing that the brightness is now only about one-twentieth that at the time of discovery, we give only the following abstract:—

1898.	R.A. h. m. s.	Decl. ° ′	Br.
August 26	6 25 22	+51 13·4	0·055
Sept. 1	29 22	51 0·9	0·053
„ 7	32 14	50 50·9	0·050
„ 13	33 56	50 43·1	0·048
„ 19	34 27	50 37·4	0·047
„ 25	33 39	50 33·5	0·046
Oct. 1	6 31 33	+50 30·4	0·044

During the above period the comet passes from the north-eastern part of Auriga into the constellation of the Lynx.

PARALLAXES AND MASSES OF γ VIRGINIS AND γ LEONIS.—The mass and dimensions of a binary system can be readily calculated if the parallax as well as the apparent size of the orbit be known, but there is another possible method of arriving at the same facts without a previous knowledge of the parallax. This consists in a measurement of the relative velocities of the two components, from which, the period being known, the circumference or semi-axis major of the orbit at once follows, so that, in addition, the parallax itself can be determined in the case of telescopic binary stars. In spectroscopic binaries, where the velocities are usually very great, the spectroscopic measurement of the relative orbital velocity is easy, but it becomes a much more difficult matter in the case of slowly moving telescopic binaries. Dr. Belopolsky, however, has had the courage to attack the problem, and has applied the spectroscopic method to γ Virginis and γ Leonis (*Ast. Nach.*, 3510). The 30-inch refractor at Pulkowa, he tells us, permits the investigation of the spectra of stars down to magnitude 4·5, and enables him to separately photograph the spectra of the components of double stars which are not less than 3″ apart.

In the case of γ Virginis the mean values of the velocities of the components in the line of sight, with respect to the sun, were found to be −2·926 g.m. (13·49 Eng. miles) per sec. and −2·648 g.m. (12·21 Eng. miles) per sec. respectively for the northern and southern components. It follows, then, that the velocity of the northern component with respect to the southern one is −0·278 g.m. (1·28 Eng. miles) per sec., from which the relative orbital velocity can be deduced. Following the methods of Lehman-Filhes, and adopting Doberck's elements of the orbit, which give a semi-axis major of 4″ and a period of 180 years, Dr. Belopolsky arrives at the following results for the system of γ Virginis:—

Semi-axis major ...	=	79·4 astronomical units.
Combined mass ...	=	15 sun's mass.
Parallax	=	0″·051
Velocity of system in line of sight ...	=	−2·79 g.m. (12·86 Eng. miles) per sec.

In the case of γ Leonis, where the components are 3″·2 apart, and have magnitudes of 2·0 and 3·5 respectively, the mean velocity in the line of sight of the brighter component, including the Potsdam measurements, is −5·32 g.m. (24·53 Eng. miles) per sec. with respect to the sun, while that of the companion, as measured at Pulkowa, is −5·03 g.m. (23·19 Eng. miles) per sec. The relative velocity is therefore +0·29 g.m. (1·34 Eng. miles) per sec., if the brighter component be regarded as the central body. Adopting Doberck's elements, giving the semi-axis major as 2″·0 and the period as 402·6 years, Dr. Belopolsky finds the following results:—

Semi axis major ...	=	102 astronomical units.
Combined mass ...	=	6·5 sun's mass.
Parallax	=	0″·0197.
Velocity of system in line of sight ...	=	− 5·18 g.m. (23·88 Eng. miles) per sec.

The investigation is one of such delicacy that considerable uncertainty remains as to the data deduced; but the individual results appear to be sufficiently consistent to warrant the publication of the foregoing provisional values. The results are especially interesting as being the first practical outcome of a suggestion first made by Fox-Talbot in 1871, and developed mathematically by Dr. Rambaut and Dr. See (NATURE, vol. liii. p. 15).

A CATALOGUE OF FOURTH-TYPE STARS.—The Rev. T. E. Espin has recently revised his valuable catalogue of stars of the fourth type (Group VI.) which are at present known, including stars discovered at Harvard and Arequipa, and not before published (*Monthly Notices*, vol. lviii. p. 443). The following summary shows the distribution of the stars in magnitude and in the two hemispheres, the magnitudes of variable stars being entered according to their maxima:—

Mag.	N.	S.	Total.
to 6·0	3	4	7
6·1 ,, 7·0	12	11	23
7·1 ,, 8·0	19	20	39
8·1 ,, 9·0	51	25	76
Below 9·0	69	11	80
Mag. not given	1	11	12
Total ...	155	82	237

It is considered probable that our knowledge of the number of stars of this type is complete for the northern heavens as far as 8·9, and for the southern heavens as far as 8·5. The catalogue contains twenty-eight variables to which letters have been assigned, twenty-two being north and six south. "It would appear that almost all the stars of Type IV. are subject to fluctuations in brightness, though the red colour makes it not easy to decide when the variation is small."

A YORKSHIRE MOOR.[1]

II.

THE Bilberry (or Blueberry, as we ought to call it) is one of the few exceptions to the rule that moorland plants are evergreen; it casts its leaves in early winter. But the younger stems are green, and take upon themselves the function of leaves, when these are absent. Kerner has described one adaptation of the Bilberry to seasons when water is scarce. Many plants, especially those of hot and wet climates, throw off the rain-water from their tips, and so keep the roots comparatively dry; others direct the water down the branches and stem to the roots. Bilberry is one of the latter sort. The rounded leaves slope downwards towards the leaf-stalk, and from the base of every leaf-stalk starts a pair of grooves, which are sunk in the surface of the stem. A light summer shower is economised by the guiding of the drops towards the roots. Bilberry abounds on the loose and sandy tracts of the moor, and especially on its verges; it is seldom found upon a deep bed of peat.

There is a moorland plant which may be said to mimic the heaths, as a Euphorbia mimics a Cactus, or Sarracenia a Nepenthes. Similarity of habit has brought about similarity of structure. The plant I mean is the Crowberry, which is so like a true heath in its foliage and manner of growth, that even the botanists, who did not fail to remark that the flowers are altogether different, long tried to bring the Crowberry and the heaths as near together in their systems as they could. Crowberry has the long, dry, wiry stems, the small, narrow, rolled, clustered, evergreen leaves of a true heath. The leaf-margins are turned back till they almost meet, and the narrow cleft between them is obstructed by close-set hairs, so that the transpiring surface is effectually sheltered. Crowberry is a peat-loving shrub, and is often found with ling and other heaths in the heart of the moor. The berries are a favourite food of birds, which help to disseminate the species. Crowberry has an uncommonly wide distribution, not only in the Arctic and Alpine regions of the Old World, but also in the New. It abounds in Greenland, where the Eskimo use the berries as food, and extract a spirit from them. A very similar species, with red berries, occurs in the Andes.

The heaths, Bilberry, Crowberry, and many other peat-loving shrubs or trees, have a peculiar root-structure. The usual root-hairs are wanting, and in their place we find a peculiar fungus-growth, which invades the living tissues of the root, sometimes penetrating the cells. There is often a dense mycelial mantle of interwoven filaments, which covers all the finer roots. This looks like parasitism, but the fungus is apparently not a mere parasite, for the tree or shrub shows no sign of injury, but thrives all the better when the fungus is plentiful, and may refuse to grow at all if the fungus is removed. Rhododendron, Ling, most heaths, Bilberry, Crowberry, Broom, Spurge-laurel, Beech and Birch are among the plants which have a mycelial mantle.

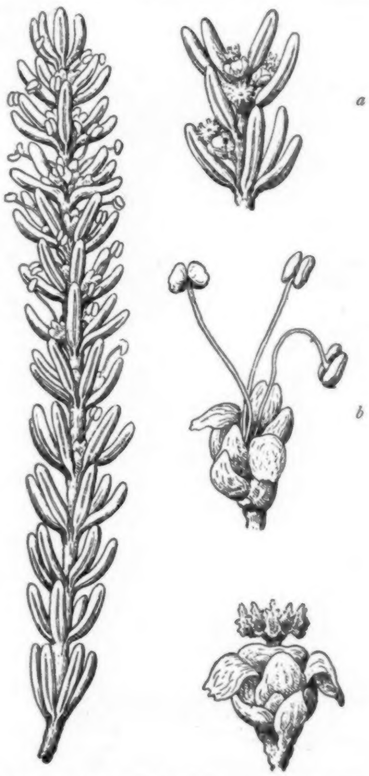


FIG. 7.—Crowberry (*Empetrum nigrum*). A staminate branch, slightly enlarged; *a*, part of a pistillate branch; *b*, one staminate flower; *c*, one pistillate flower.

If the native soil which clings to the roots of any of these is completely removed, if the fine roots with the mycelial mantle are torn off by careless transplanting, or if peaty matter is withheld, the plant dies, or struggles on with great difficulty until the mycelial mantle is renewed. Such plants cannot, as a rule, be propagated by cuttings, unless special precautions are taken. Frank maintains that the mycelial mantle is the chief means of absorption from the peaty soil, and that the tree or shrub has come to depend upon it. The known facts render this interpretation probable, but thorough investigation is still required. In some cases at least the plant can be gradually inured to the absence of a mycelial mantle. I have repeatedly planted crowberry in a soil devoid of peat. It generally succumbs, but when it survives the first year, it maintains itself and slowly spreads. Microscopic examination shows that the roots of crowberry grown without peat contain no mycelial filaments or very few.

[1] A discourse given at the Royal Institution, February 1898. By Prof. L. C. Miall, F.R.S. Continued from p. 380.

The special function of the fungus may be to reduce the peat to a form capable of absorption as food by green plants. It is likely that the fungus gains protection or some other distinct advantage from the partnership. Most of the species of green plants which have the mycelial mantle are social. It is obvious that the fungus will be more easily propagated from plant to plant, where many trees or shrubs of the same species grow together.

The grasses of the moor are marked xerophytes, with wiry leaves, whose look and feel tell us that they have adapted themselves to drought and cold by reducing the exposed surface

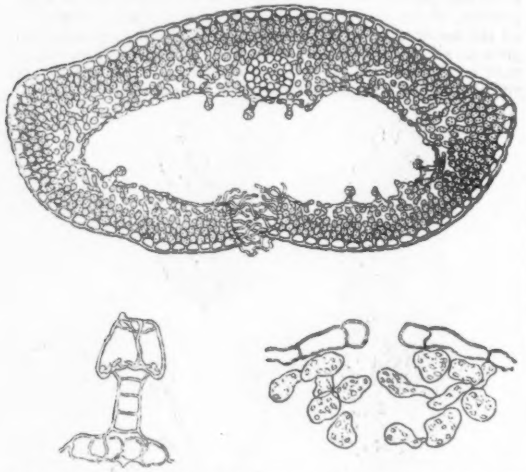


FIG. 8.—Cross-section of leaf of Crowberry. The lower figures show one of the peculiar hairs and one of the stomates. Both are confined to the inner, which is properly the under surface.

to a minimum. A section of the leaf of Nardus, Aira flexuosa, or Festuca ovina shows that the upper surface, which in grasses bears the stomates, is infolded, and sometimes greatly reduced. Advantage has been taken by these grasses of a structure which was apparently in the first instance a provision for close folding in the bud. The upper, stomate-bearing surface is marked by furrows with intervening ridges, and where the folding is particularly complete, both furrows and ridges are triangular in section, and the leaf, when folded up longitudinally, becomes an almost solid cylinder. In the grasses of low, damp meadows, the power of rolling up may soon be lost by the leaves. Other grasses, which are more liable to suffer from drought, retain in

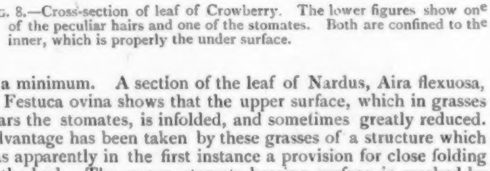


FIG. 9.—Longitudinal section of root of Ling (*Calluna vulgaris*), showing mycorhizal filaments in outer cells.

all stages the power of rolling up their leaves. Sesleria cærulea, for instance, which covers large tracts of the limestone hills of Yorkshire, can change in a few minutes from closed to open, or from open to closed, according to the state of the air. The leaves of the true moorland grasses (Nardus, Aira flexuosa, Festuca ovina) are permanently inrolled, and flatten out very slowly and imperfectly, even when immersed in water for many hours.

Our moorland grasses are all arctic, and occur both in the old and the new worlds; Festuca ovina is also a grass of the steppes; it is world-wide, being found in all continents, especially on mountains, and even reaching Australia and New Zealand.

It may seem paradoxical to count the Rushes as plants which are protected against drought, for they often grow in the wettest part of the moor. They are common, however, in dry and stony places, and their structure is completely xerophytic. The leaves are often reduced to small sheaths, which wither early, while the stems are green, and perform the work of assimilation;

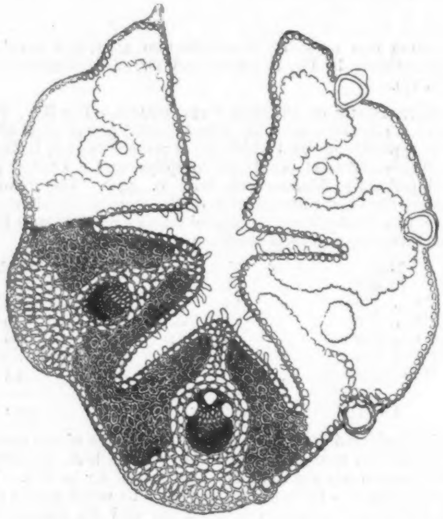


FIG. 10.—Transverse section of leaf of *Nardus stricta*, showing permanent in-rolling.

or else, as happens in certain species, the leaves assume the ordinary structure of the stem. The cylindrical form of the Rush-stem is significant, for of all elongate solid figures the cylinder exposes the smallest surface in proportion to its volume. Moreover a cylindrical stem, without offstanding leaves, and alike on all sides, is well suited, as Jungner points out, to the circumpolar light, which shines at low angles from every quarter

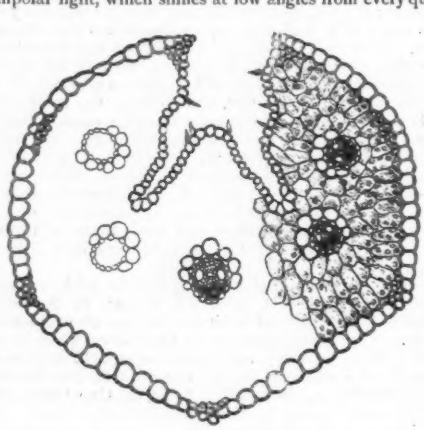


FIG. 11.—Transverse section of leaf of *Aira flexuosa*.

in succession. A Rush-stem is singularly dry, the centre being occupied by an abundant pith of star-shaped cells, which entangle much air.

The Hair-moss (Polytrichum commune) of the moor has a defence against sun and wind, which has been described by Kerner. The leaf has wings, like an altar-piece, which can open and shut. The assimilating surface occupies the centre,

and rises into many green columns. In wet or cloudy weather the wings open wide, but when the sun shines they fold over the columns, and protect them from scorching.

All the most characteristic plants of the moors are Arctic. Ling, bilberry, crowberry, certain rushes, Nardus, Festuca ovina, most of our club-mosses, the hair-moss, and Sphagnum range within the Arctic Circle; while the large flowered Heaths get close up to it. Most of them are found on both sides of the Atlantic, and some, like the crowberry and Festuca ovina, have a singularly wide distribution.

It has often been pointed cut that great elevation above sea-level produces a similar effect upon the flora to that of high latitude. In the Alps, the Pyrenees, the Himalayas, and even in the Andes, the forms characteristic of northern lands re-appear, or are represented by allied species. Where, as in the case of the Andes, nearly all the species differ, it is hard to draw useful conclusions, but whenever the very same species occur across a wide interval the case is instructive. In the Alps we find our moorland and arctic flora almost complete, though Rubus Chamæmorus, Erica Tetralix, and E. cinerea (both found in the Pyrenees), Narthecium ossifragum and Aira flexuosa have disappeared.

A favourite explanation rests upon the changes of climate to which the glaciation of the northern hemisphere bears emphatic witness. When the plains of Northern Europe were being strewn with travelled boulders, when Norway, Scotland, and Canada were covered with moving ice, the vegetation of

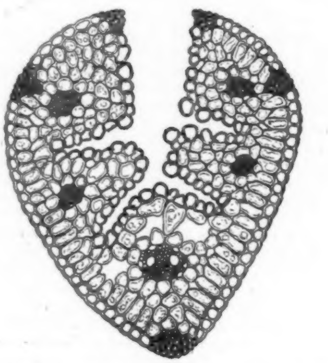


FIG. 12.—Transverse section of leaf of *Festuca ovina*. In thick sections hairs are seen to point inwards from the inner epidermis.

Siberia and Greenland may well have extended as far south as Switzerland.

I do not doubt the general truth of what we are taught respecting the glacial period, but I think that we are apt to explain too much by its help. We know very little for certain as to its effect upon vegetation. Our information concerning the preglacial flora is extremely meagre, nor are we in a position to say positively what sort of flora covered the plains of Europe after the severity of glacial cold had passed away, and before men had changed the face of the land by tillage.[1] We know rather more about the animals of these ages, for animals leave more recognisable remains than plants, but the indications of date, even in the case of animals, are apt to be slight and uncertain. On the whole, I doubt whether the glacial period marks any great and lasting change in the life of the northern hemisphere.[2] I think it probable that since the glacial period passed away the countries of Central Europe possessed many species both of plants and animals which we should now consider to be Arctic, and that these Arctic species endured until many of them were driven out by an agent of which geologists usually take little notice. I shall come back to this point.

The animal life of the Yorkshire moors is not abundant. Hares, shrews, stoats, weasels, and other small quadrupeds, which are plentiful on the rough pastures, cease where the heather begins. There are a good many birds, some of which, like the grouse, the ring-ouzel, the twite, or mountain-linnet, the curlew, and the golden plover, seek all their food on the moor, except in the depth of winter, when some of them may visit the sea-coast, or the cultivated fields, or even southern countries. The kestrel, blackbird, whinchat, stonechat, night-jar, and lapwing abound on the "roughs" or border-pastures rather than on the moor itself. Owing to the absence of tarns and lochs there are practically no waterfowl. Gulls are hardly ever seen, though they are common enough on the Northumberland moors. Now that the peregrine, golden eagle, and hen-harrier are exterminated, the chief moorland birds of prey are the merlin, kestrel, and sparrowhawk. Of these only the merlin is met with in the wilder parts of the moor, where it flies down the smaller birds. The kestrel hovers over the roughs, on the look-out for a mouse or a frog. The sparrow-hawk preys upon small birds, but rarely enters the heart of the moor.

To most people the interest of the moor centres in the grouse. There are many things about grouse which provoke discussion, such as its feeding times, or the grouse-fly, and what becomes of it during the months when the grouse are free of it. But the

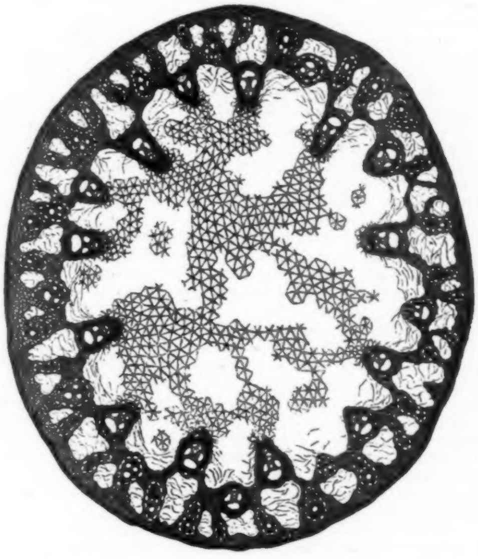


FIG 13.—Transverse section of stem of Rush (*Juncus conglomeratus*), showing the stellate pith-cells, and very numerous air-spaces.

absorbing topic, on which every dweller by the moor is expected to have an opinion, is the grouse-disease.

All sorts of causes have been assigned, such as over-stocking of the moors, destruction of the large hawks which used to kill off ailing birds, parasitic worms, cold, deficiency of food, and so on. Some Yorkshire sportsmen have attributed the disease to the scarcity of gritty sand. On shale-moors, they maintain, the gizzard of the grouse is filled with soft stones, which will not grind up the heather-tops effectively, except when they are young and tender. On sandstone moors the grouse can deal with tougher food, and there the disease, it is said, is unknown. Dr. Klein's researches[1] show that the disease is really due to the multiplication within the body of a specific germ, which is fungal, but not bacterial. The infection is conveyed, or may be conveyed, by the air.

The viper is rare, and until quite lately I had never heard of its presence on our Yorkshire moors. Lizards are also rare, but efts are not uncommon. Among the moorland moths are many small Tineina (allied to the clothes-moth). The caterpillar of the emperor moth is characteristic, and seems to be protectively coloured, for it wears the livery of the heather—green and pink.

[1] Some information has been gained by investigation of plant-remains found beneath the bogs of Denmark, and beneath the palæolithic brick-earth at Hoxne.

[2] It is well known that this position has been strongly maintained by Prof. Boyd Dawkins ("Early Man in Britain," p. 123, &c., *Q. J. Geol. Soc.*, vol. xxxv., p. 727, and vol. xxxvi., p. 399). On the other side, Dr. James Geikie may be consulted ("Prehistoric Europe," ch. iii., &c.).

[1] "The Etiology and Pathology of Grouse Disease, &c." (1892).

The moths which issue from these larvæ are captured in great numbers by Sunday ramblers, who resort to the base contrivance of bringing a female moth in a cage. The self-styled "naturalist" sits on a rock, and captures one by one the eager moths which come about him, afterwards pinning out the expanded wings to form grotesque patterns, or selling his specimens to the dealers. Certain wide-spread Diptera are plentiful, and there are a few which pass their larval stages in the quick-running streams which flow down from the moor. The small number of good-sized insects partly explains (or is explained by) the paucity of conspicuous scented or honey-bearing flowers. In this the moor contrasts strongly with the higher Alps. Bees, however, get much honey from the large-flowered heaths and ling; heather-honey is considered better than any other. A little scale insect (*Orthesia uva*) has been found plentifully on the Sphagnum of the moors, particularly in Cumberland.[1] A big spider (*Epeira diadema*) spreads its snare among the heather, and may now and then be seen to deal in a particularly artful fashion with a wasp or other large insect which may have blundered into the web. The spider cuts the threads away till the struggling insect dangles; cautiously on outstretched leg holds out and attaches a new thread, and then sets the wasp spinning. The silken thread, paid out from the spinneret, soon binds the victim into a helpless mummy.[2] I have never found gossamer so abundant as on the verges of the moor.

In our day the Yorkshire moor harbours no quadrupeds, and the grassy hills none but small quadrupeds. It was not always so. At Raygill, a few miles from us across the moors, a collection of bones was discovered a few years ago in quarrying. A deep fissure in the rock had been choked ages before with stones and clay. This fissure was cut across by the working face of the quarry. Many bones were brought out of it, bones of the ox and roebuck among the rest. But mixed up with these were teeth and bones of quadrupeds now altogether extinct or no longer found in Britain, such as the straight-tusked elephant (*E. antiquus*), the hippopotamus, a southern rhinoceros (*R. leptorhinus*), the cave hyæna, and the European bison. The Irish elk is often dug up in Yorkshire, the reindeer and the true elk now and then. Not very long ago these and other large quadrupeds grazed or hunted a country which can now show no quadruped bigger than a fox.

It is evident that the moors, valleys and plains of Yorkshire have been depopulated in comparatively recent times. The disappearance of so many conspicuous species is commonly attributed to the glacial period, but I think that the action of man has been still more influential. The extinct animals are such as man hunts for profit or for his own safety. Many of them, among others the cave-bear, Machairodus, Irish elk, mammoth, and straight-tusked elephant, are known to have lasted into the human period. That so many of them were last seen in the company of man is some proof that he was concerned in their death.

Central Europe, before man appeared within its borders, or while men were still few, little resembled the Europe which we know. Much of it was covered with woods, morasses or wastes, and inhabited by animals and plants, of which some ranged into the Arctic circle, others to the Mediterranean, Africa and India. The worst lands of all—cold, wet, and wind-swept—had doubtless then, as now, the greatest proportion of Arctic species. But it is likely that the passage from the bleak hills to the more fertile valleys and plains was not then so abrupt as at present. All was alike undrained and unenclosed; and what we know of the distribution of life in Pleistocene Europe shows us that a large proportion of our European animals and plants are not restricted by nature within narrow limits of latitude or climate. Species which are now isolated, at least in Central Europe, occupying moors or other special tracts, and surrounded by a population with which they have little in common, were formerly continuous over vast areas. In the early days of man in Europe many plants, birds, and quadrupeds which are now almost xclusively Arctic may well have ranged over nearly the whole of Europe.

As men gradually rooted themselves in what are now the most populous countries of the world, the fauna and flora underwent sweeping changes. The forests were cleared, and trees of Imported species planted here and there. The land was drained, and fenced, and tilled. During the long attack of man upon wild nature many quadrupeds, a few birds, some insects, and some plants are known to have perished altogether. Others have probably disappeared without notice. Certain large and formidable quadrupeds, though they still survive, are no longer found in Europe, but only in the deserts of the south or the unpeopled northern wastes. Thus the lion, which within the historic period ranged over Greece and Syria, and the grizzly bear, which was once an inhabitant of Yorkshire, have disappeared from every part of Europe. Tillage and fencing have checked the seasonal migrations of the reindeer and the lemming. Useful animals have been imported, chiefly from the south or from Asia. Useful plants have been introduced from ancient centres of civilisation, and common farm-weeds have managed to come in along with them. Many species of both kinds are southern, many eastern, none are Arctic. In our day the cultivated lands of Europe are largely occupied by southern or eastern forms, and the wastes appear by contrast with the imported population more Arctic than they really are. Even the wastes are shrinking visibly. The fens are nearly gone, and we shall soon have only a few scattered moors left to show what sort of vegetation covered a great part of Europe in the days of choked rivers and unfenced land. The moors themselves cannot resist the determined attack of civilised man. Thousands of acres which used to grow heather are now pastures or meadows.

What we call the Arctic fauna and flora of to-day is apparently only the remnant of an assemblage of species varying in hardiness, which once extended from the Arctic circle almost to the Mediterranean. If climate and soil alone entered into the question, it is likely that the so-called Arctic fauna and flora might still maintain itself in many parts of Central Europe. This Arctic (or ancient European) flora includes many plants which are capable of withstanding extreme physical conditions. Some thrive both on peat and on sand, in bogs and on loose gravel. They may range from sea-level to a height of several thousand feet. They can endure a summer glare which blisters the skin, and also the sharpest cold known upon this planet. Some can subsist on soil which contains no ordinary ingredient of plant-food in appreciable quantity. Such plants survive in particular places, even in Britain, less because of peculiarly appropriate surroundings, or of anything which the microscope reveals, than because they can live where other plants perish. Ling, crowberry, and the rest are like the Eskimo, who dwell in the far north, not because they choose cold and hunger and gloom, but because there only can they escape the competition of more gifted races. The last defences of the old flora are now being broken down; it is slowly giving way to the social grasses, the weeds of commerce, and the broad-leaved herbs of the meadow, pasture, and hedge-row. The scale has been turned, as I think, not so much by climatic or geographical changes, as by the acts of man.

Every lover of the moors would be glad to know that they bid fair to be handed down to our children and our children's children without diminution or impoverishment. The reclaiming of the moors is now checked, though not arrested, and some large tracts are reserved as open spaces. But the impoverishment of the moors goes on apace. The gamekeeper's gun destroys much. Enemies yet more deadly are the collectors who call themselves naturalists, and the dealers who serve them. A botanical exchange club has lately exterminated the yellow Gagea, which used to grow within a mile of my house. Whenever a kingfisher shows itself, young men come from the towns eager to slay it in the name of science. No knowledge worth having is brought to us by such naturalists as these; their collecting means mere destruction, or at most the compilation of some dismal list. If the selfish love of possessing takes hold of any man, let him gratify it by collecting postage-stamps, and not make hay of our plants and mummies of our animals. The naturalist should aspire to study live nature, and should make it his boast that he leaves as much behind him as he found.

THE MARINE FAUNA IN LAKE TANGANYIKA, AND THE ADVISABILITY OF FURTHER EXPLORATION IN THE GREAT AFRICAN LAKES.

THERE is a story which redounds to the sagacity of a certain Dutch farmer, who, on the sudden appearance of herrings in the ditches on his property, sold it, on account of the indisputable evidence which such fish afforded, of the leaky condition of the dykes. The Dutchman's inference will serve to

[1] Shaw (1806), quoted by R. Blanchard in *Ann. Soc. Ent. Fr.*, tom. lxv. p. 681 (1896).

[2] Blackwall's "Spiders," vol. ii. p 359.

indicate how much surprise the discovery of jelly-fish in Lake Tanganyika, by Dr. Boehm, created in the minds of those who were interested in the past history of the great lakes in Africa, for, in the presence there even of a single organism so typically marine, and so unlike any real fresh-water form as a medusa, there was as good, indeed far better, evidence for the former access of the sea to those regions, than that which was afforded by the herrings in the Dutchman's ditch.

It was partly because I held this view, in regard to the presence of jelly-fish in Tanganyika, more especially because Prof. Lankester pointed out to me that where there were jelly-fish one might reasonably expect to find other marine organisms, similarly cut off, that I went to Tanganyika in 1895. The results of that expedition have fully justified these views, and during the past year, in which the zoological material obtained has gradually been overhauled, it has become more and more apparent that in Tanganyika we have not only a jelly-fish, but the remains of an entire fauna, which can be regarded as nothing but the relic of the former extension of some ancient sea.

Thus besides the jelly-fish there exist on the rocks about the shores, and in the deep water of the lake, numbers of molluscs, which not only in their shell structure, but also in their organisation, show clearly that they belong to those groups which have generally remained marine, and which have never given rise to any of the colonising fresh-water types. Besides these there are at least two forms of prawns, a deep-water crab, and several forms of protozoa, all possessing like marine affinities.

At the same time it is most important to remember that Tanganyika contains its full complement of recognised fresh-water forms, which are similar to those constituting the entire fauna of lakes such as Nyassa, Mwero, and the like, and that these fresh-water types in Tanganyika differ from those in Lake Mwero and Nyassa only to the same extent that those in Lakes Mwero and Nyassa differ from each other. It is thus obvious, and one of the most important results hitherto obtained, that the fauna of Lake Tanganyika is to be regarded as a double series, one half consisting of forms which are found everywhere in the African fresh waters, the other of what we may call *halolimnic* organisms, which are found living nowhere else in the world, at least so far as is at present known.[1]

In the incomplete state of our knowledge of the Halolimnic fauna, it is undoubtedly the mollusca belonging to this group, which are the most instructive at the present time; for among these organisms there are a considerable number of types which are widely different from each other, and all of which can be compared with living oceanic forms. We have here, therefore, a basis of comparison broad enough to give a clear and trustworthy conception of their nature and their actual affinities.

In this way it is clearly seen that in several genera of the Halolimnic molluscs, such as *Typhobia*, *Bathanalia*, and others, we have forms which individually do not correspond exactly to any single living oceanic species, but which at the same time, in the curious character of their organisation, do very distinctly foreshadow and combine the anatomical features not of one, but of several living oceanic species which are now quite distinct from one another. The only conclusion, therefore, that can be drawn from this remarkable character of the Halolimnic forms, is that they have been cut off approximately all at the same time from their original marine associates at an extremely ancient date. In fact, that they still retain combined the original characters of the organisms whose progeny in the ocean has become completely differentiated into forms that are now specifically and even generically distinct.

These Halolimnic molluscs stand, therefore, to such oceanic species in the relation of ancestral types.

This inference respecting the great antiquity of the marine fauna in Tanganyika, which we gather from the peculiarities of the organisation of the individual Halolimnic forms, is in exact accord with what we should expect when contemplating the vast physical changes which must have been produced since there was any possibility of Lake Tanganyika communicating freely with the sea. But although from both these sources of evidence we are assured that the Halolimnic fauna is certainly a "hoary relic" of the past, they are neither of them capable of affording any indication of the particular geological period during which the marine contamination of this part of the African interior actually took place.

Quite recently, however, there has come to hand a series of observations which appear to be of the highest interest in this connection, and capable of throwing a considerable amount of light upon the perplexing question of the relative antiquity of the Halolimnic forms. It has been found, after comparing the peculiar shells of many of the Halolimnic molluscs, such as those of the two forms of *Limnotrochus*, the genus *Bathanalia*, *Spekia*, *Paramelania*, and so forth, with the fossilised remains of the molluscs occurring in successive geological periods, that there exists a wonderful similarity between the general facies of the shells belonging to the marine fauna of Lake Tanganyika and those of the old Jurassic seas. This is no merely superficial resemblance between single types, but a substantial conchological identity between so many Halolimnic genera and species and an equal number of forms occurring in the Lias and Inferior Oolitic rocks, that it at once arrests attention, and requires us to consider very carefully, whether we are to regard this similarity of the two series as merely a coincidence, or the expression of some real community of nature and descent.

Without entering too fully into the details of this subject, it may be stated, as the result of a careful comparison of these forms, which will be found fully described in a paper in the *Quart. Journ. Micro. Sci.*, vol. xli. No. 162, June 1898, that the comparison is so striking and so complete in detail, that had the Halolimnic molluscs been known only in some fossiliferous bed, there is not the slightest doubt that even the most fastidious palæontologist, unless he had a particular theory to support, would regard them as unquestionably belonging to Jurassic seas.

Taking, therefore, a retrospective view of the whole matter, it will be seen that the original discovery of jelly-fish in Tanganyika has led us a long way beyond the mere demonstration of the existence of a marine animal in the African interior. It has brought to light the existence of a long series of other marine organisms, which, judged by the nature of their organisation, are unquestionably very old, while, finally, we have obtained evidence which appears to indicate that, at any rate, the molluscs still living in this marine oasis in "terra firma," are relics from Jurassic seas.

Thus the purely scientific interest of the Halolimnic fauna consists mainly in the way in which the different forms composing it afford an insight into the structural peculiarities of a number of types of organisation which were thought to have long since become extinct; but at the same time the presence of this fauna in Tanganyika is destined to throw a world of light on the past history of the continent in which it lives, and it is all the more interesting in this latter sense, because the past history of the African lakes, as read in the light of the Halolimnic group, is not that which many geologists, particularly Sir Roderick Murchison, have supposed it to have been.

I have thus briefly outlined the extent and nature of the latest information which has been acquired respecting the zoology of the African lake districts, and the extent to which these observations may change existing preconceptions, and throw old problems into new perspective, will constitute their value from a philosophic point of view. But for the practical ends and advancement of zoology, it will be obvious that the conclusions which have been attained respecting the vast antiquity of the Halolimnic forms, foreshadow the possibilities of almost infinite developments, and that the value of further exploration of these lakes, as a zoological speculation, has become immense.

It is therefore greatly to be regretted that during my recent expedition, under the circumstances in which I found mysel. (without a steamer, and consequently unable to use deep-water dreging apparatus), it was quite impossible to form even an approximate estimate of the range of animals one might expect to encounter in the Tanganyika, and more exasperating than this was the fact that the most interesting Halolimnic forms, the *Typhobias*, *Bathanalias*, and their associates, only appeared just at the limit of my dredging powers, about 1000 to 1200 feet. It was thus only when the dredging capacities of the expedition, so to speak, were giving out, that the more interesting representatives of the Halolimnic fauna were beginning to come in, and there is no doubt that with a steamer and efficient apparatus for great depths, many entirely new forms would be obtained. To show how incomplete our knowledge of the fauna of Lake Tanganyika at present really is, it may be pointed out that although twenty-eight entirely new species of fish were obtained during my expedition, of the four species previously known from this lake I only re-discovered one (see Appendix).

It should, however, be clearly understood that the zoological and geological interest which the possible existence of new

[1] See my papers, *Proc. Roy. Soc.*, vol. lxii., 1898, pp. 452–458; and *Quart. Journ. Micr. Sci.*, vol. xli. pp. 159–180.

Halolimnic forms naturally excites, is not necessarily restricted to the particular basin in which Tanganyika lies; indeed, we have to thank Prof. Süss[1] for collecting the existing observations in such a manner that we are now not only able to separate the lakes into two distinct series, of which the Victoria Nyanza and Tanganyika are types respectively, but to show clearly that the singular Tanganyika valley is geologically related to the similar valleys in which numerous other long and narrow lakes are found to lie. Süss showed that the continued existence of these valleys could be traced north and south in Africa, from the Nyassa region to the Red Sea, and that the narrow gulf in which the Red Sea is itself contained, must be regarded as of the same nature and construction.

Now the fact that there exists a marine fauna in Tanganyika, at the one extremity of the same series of valleys in which the Red Sea lies at the other, would rather lead us to expect that we may encounter the Halolimnic fauna, or something similar to it,

[1] "Die Brucke des Ost Afrika."

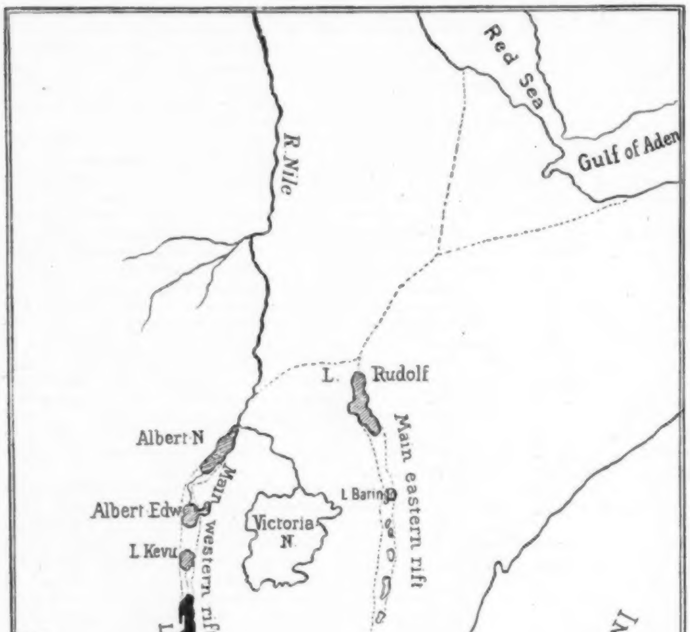


FIG. 1.—Sketch map of the Great Lake region of Africa, showing the relation of the principal lakes to the Chains of Rift valleys; and the distribution of the normal fresh-water and Halolimnic fauna in these lakes. The lakes partially shaded are those which have not yet been zoologically explored, and in which the Halolimnic fauna may be found. The one Lake Tanganyika, in which the Halolimnic fauna is now definitely known to coexist with the ordinary freshwater stock, is represented quite black; while those lakes, such as Nyassa, in which there are certainly no marine forms, are left entirely white.

in the Albert Edward and Albert Nyanza, which lie along the same depressions in between.

The facts of distribution which have actually been obtained are, however, merely these. I showed that the Halolimnic fauna does not exist in Lake Nyassa, nor in any of the subsidiary lakes which occur within the British Central African Protectorate. It is, further, certain that this fauna does not exist in Mwero or Bangweolo, the two lakes which form the western boundary of North Charterland.

In the accompanying map, these lakes are therefore represented blank. It may, however, be yet found in Rukwa, east of Tanganyika (which is consequently shaded), and it is still more likely to occur in Lake Kivu, the Albert Edward, and the Albert Nyanzas, all of which lie actually in the same valley as Tanganyika, immediately to the north, and concerning the fauna of which practically nothing is known.

Passing to the more westerly series of faults, it is certain from the collections of shells brought back by Dr. Gregory from the small lakes Naivasha, Elineteita and Baringo, that the Halolimnic fauna is not present in these districts, while the collections of Messrs. Donaldson Smith and Cavendish, from Lake Rudolf in the north, seem to tell the same story.[1] It would appear therefore, that unless some marine extension formerly existed, which was quite independent of the Rift valleys, up some such depression as that of the Rufigi and Ulanga rivers, in which case the remains thereof will be exceedingly difficult to find, both the living and dead representatives of the Halolimnic group, may be expected in the great depression north of Tanganyika, *i.e.* in the three lakes which I have named. Mr. Scott-Elliot, who descended into the northerly extension of the Tanganyika valley, between Ruanda and Mwezi's country, speaks of old lake-bottoms occcurring there above the present level of Tanganyika, as sandy plains, with banks of drifted shells! An immense amount of interest, therefore, attaches to the exploration of these lake-bearing districts immediately to the north of Tanganyika.

Referring to the map, I would therefore direct special attention to the fact that Lake Kivu is about four days' march from the extreme north of Tanganyika, along the same valley and up the lake's effluent, which flows back into the Tanganyika basin. From Kivu it is certainly not more than five days' journey to the Albert Edward, which is on the other side of the north and south watershed, and overflows into the Nile. The effluent appears, so far as I can ascertain, to be navigable for boats; and if this be so, the Albert Nyanza could be reached without trouble in five or six days; in any case, and allowing ample time for zoological work in these lakes, the whole series could be explored, in something less than two months from the time of leaving the north of Tanganyika, and all that it would be necessary to take in order to do as much as, and a good deal more than I have already done in the case of Tanganyika, would be a few suitable dredges and a couple of collapsible boats.

There is, however, another direction in which evidence bearing upon these subjects can be sought. At the present time the geology of this part of the African interior is almost entirely a

[1] I have, however, shaded Rudolf, as very little is known about the fauna it ontains.

blank; but it has been rendered evident from my expedition, as well as by those of Joseph Thomson, and Burton and Speke, that there exist all over these regions west of the Victoria Nyanza immense areas of sedimentary deposits, which extend without interruption to the north of Lake Nyassa, and here they have been proved to be fossiliferous, and it is a fact (which is on no account to be ignored) that the remains of ganoid fishes, discovered there by Henry Drummond, are not regarded by Prof. Troquhair, who described them, as being at all necessarily fresh-water forms. With the same caution, Prof. Rupert Jones, who described the Lamellibranchs occurring in these beds, intentionally placed them among those estuarine forms which might be regarded either as salt water or fresh. Still more important is the existence of what appears to be an oligocene sea-urchin, which certainly came from some portion of this region, and probably from the same fossiliferous beds.

We are thus already in possession of information which indicates the extension of fairly modern seas, far into the African interior. The ascertained existence of marine organisms in Tanganyika is certainly, therefore, in no way opposed to such geological observations as actually exist, but only as new facts usually are, to the perpetuation of crude theoretical anticipations. Our inability to account for their appearance in Lake Tanganyika, is due simply to a complete want of information respecting the geological character of the country which surrounds the lake; but it will have been rendered obvious, that sufficient information on these points can easily be obtained by a properly equipped expedition, which should travel up Tanganyika from the south, and reach, as it could do, the Albert Edward and Albert Nyanzas, by passing up the continuation of the Tanganyika valleys to the north. Now that there are steamers running both on Nyassa and Tanganyika, the deep-water dredging and sounding of both these lakes could be accomplished without much difficulty, and there is no reason, that I can see, why a geologist accompanying such an expedition should not make something of the materials of which the surrounding country is composed. At all events an amount of information would be accumulated, which would mark an epoch in our acquaintance with the zoology and geology of the African interior. What I conceive, however, to be of the first importance is this, that such an exploration is well within the limits of practicability, for the work, entailed under the different heads which I have just discussed, could be carried out by a party properly organised and properly led, well within two years from the time that it set out.

J. E. S. MOORE.

Appendix.

In order to exemplify the productive character of properly conducted zoological exploration in these regions, I have appended, under separate headings, a list of those Halolimnic molluscs, the empty shells of which were known before the present expedition was undertaken, and of the forms which have now been obtained with the animals preserved in a fit state for zoological work. In the same way I have added similar lists of the species of fish previously known to inhabit Tanganyika, and the numerous and almost entirely new forms which have now been brought back. In the older list of molluscs the conchological classification of their empty shells has been retained, in order that it may be seen how completely the acquisition of the animals has changed our views.

I.

LIST OF EMPTY SHELLS PREVIOUSLY KNOWN.

Fam. *Melaniidæ*.
Genus *Typhobia* (Smith).
T. Horei (Smith).
Genus *Paramelania* (Smith).
P. Damoni (Smith).
M. nassa (S. P. Woodw.).
Fam. *Hydrobidæ*.
Genus *Syrnolopsis* (Smith).
S. Lacustris (Smith).
Genus *Spekia* (Bourginnat).
S. zonata (S. P. Woodw.).
Genus *Tanganyicia* (Cross).
T. rufofilosa (S. P. Woodw.).
Genus *Limnotrochus* (Smith).
L. Thomsoni (Smith).
L. Kirkii (Smith).

LIST OF ENTIRE MOLLUSCS OBTAINED DURING THE EXPEDITION OF 1895 AND 1896.

Fam. *Typhobidæ* (Moore).
Genus *Typhobia* (Smith).
T. Horei (Smith).
Genus *Bathanalia* (Moore).
B. Howesei (Moore).
Genus *Limnotrochus* (Smith).
L. Thomsoni (Smith).
Fam. *? Planaxidæ*.
Genus *Tanganyicia* (Cross).
T. rufofilosa (S. P. Woodw.).
Fam. *Xenophoridæ*.
Genus *Chytra* (Moore).
C. Kirkii (Smith).
Fam. *Purpurinidæ*.
Genus *Paramelania* (Smith).
P. Damoni (Smith).
P. crassigranulata (Smith).
Genus *Nassopsis* (Smith).
N. nassa (S. P. Woodw.)
Genus *Bythoceras* (Moore).
B. iridescens (Moore).
Fam. *Naticidæ*.
Genus *Spekia* (Bourginnat).
S. zonata (S. P. Woodward).

II.

LIST OF FISHES KNOWN PREVIOUSLY.

Acanthopterygii.
Fam. *Cotchlidæ*.
Genus *Tilapia* (Gthr.).
T. Tanganyicea (Gthr.).
T. Burtoni (Gthr.)
Genus *Mastacembelus*.
M. Tanganyicea (Gthr.)
M. Ophictrum (Gthr.).

LIST OF FISHES OBTAINED DURING THE EXPEDITION.

Acanthopterygii.
Fam. *Serranidæ*.
Genus *Lates*.
L. microlepis, sp. n.
Genus *Lamprologus*, nov. gen.
L. fasciatus, sp. n.
L. compressus, sp. n.
L. Moorei, sp. n.
L. modestus, sp. n.
L. elongatus, sp. n.
L. fuscifer, sp. n.
Genus *Telmatochromis*, nov. gen.
T. vitatus, sp. n.
T. temporalis, sp. n.
Genus *Julidochromis*, nov. gen.
J. ornatus, sp. n.
Genus *Paratilapia*, nov. gen.
P. pfifferi, sp. n.
P. macrops, sp. n.
P. ventralis, sp. n.
P. fuscifer, sp. n.
P. leptosoma, sp. n.
Genus *Bathybates*, nov. gen.
B. ferox, sp. n.
Genus *Eretmodus*, nov. gen.
E. cyanosticus, sp. n.
Genus *Tilapia*.
T. labiata, sp. n.
Genus *Tropheus*, nov. gen.
T. Moorei, sp. n.
Genus *Petrochromis*, nov. gen.
P. polyodon, sp. n.
Genus *Perissodus*.
Genus *P. microlepis*, sp. n.
Fam. *Mastacembelidæ*.
Genus *Mastacembelus*.
M. Moorei, sp. n.
Physostomi.
Fam. *Siluridæ*.
Genus *Clarias* (L.).
C. angularis (L.).
C. biocephalus, sp. n.
Genus *Anoplopterus* (Gthr.).
A. platychir (Gthr.).
Genus *Auchinaspis* (Cuv.).
A. biscutata (Cuv.).
Genus *Synodontis*.
S. multipunctatus, sp. n.
Genus *Malapterurus*.
M. electricus.
Fam. *Characinidæ*.
Genus *Alestes*.
A. macrolepidotus (C. and V.).
A. macrophtralmus (Gthr.).
Genus *Hydrocyon* (C.).
H. forskalii.
Fam. *Cyprinidæ*.
Genus *Labio*.
L. ?
Fam. *Cyprinodontidæ*.
Genus *Haplochilus*.
H. tanganicanus, sp. n.
Fam. *Polypteridæ*.
Genus *Polypterus*.
P. Bichir ?

From the above list of fishes, which has been courteously supplied to me by Mr. Boulenger, and which are themselves now in the British Museum, it will be seen that there has been added from this single locality an extraordinary number of entirely new types. In fact, almost the entire fish population of Tanganyika, so far as at present known, is composed of forms which are quite peculiar to the lake. When, therefore, we remember that all these fishes were obtained without deep or even rough water nets and trawls, and that I was only able, as it were, to scratch round some 150 miles of the shallow coast line of a lake over 350 miles in length, and of unknown depth, it will be evident to all, how much must remain there in the way of fishes which have not yet been obtained. But what is true of Tanganyika in this respect, is almost equally true of Lake Nyassa, for no deep-water work of any kind has hitherto been accomplished there, nor is the depth of this lake known. It has been shown to extend to 300 fathoms, but no bottom was obtained; and it consequently follows that wherever the deep floor of Nyassa really is, it is far below the level of the sea.

Thus although it is obvious that we know next to nothing of the zoological contents of Nyassa and Tanganyika, our comparative ignorance of the fauna of these two great lakes is as nothing compared to the absolute want of information appertaining to the aquatic zoology of Lake Rukwa, or of the great Nyanzas north of Tanganyika, the interesting relations of some of which to the Tanganyika valleys I have already pointed out. I hope, therefore, it will become apparent how huge a field for further zoological investigation the energy and enterprise of the

great African companies, and the administration of the African Protectorate has opened up to us, as a sort of unconscious gift to science, wherein the problems raised originally by Boehm's jelly-fish may be followed up, not in imagination only, but with the pleasant certainty of tangible results. J. E. S. M.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. LUCIANI, Professor in Human Physiology in the University of Rome, whose work on the functions of the cerebellum is well known throughout the scientific world, has (says the *British Medical Journal*) been elected Rector of the Rome University for the academic year 1898–99. Dr. Corona, Professor of Experimental Physiology and President of the Faculty of Medicine of the Parma University, has been elected Rector of this University.

THE following list of this year's successful candidates for Royal Exhibitions, National Scholarships, and Free Studentships (Science), has been issued by the Department of Science and Art:—Royal Exhibitions—George S. Taylor, Devonport; Leslie H. Hounsfield, London; William McG. Wallace, Crewe; William W. Firth, Oldham; Henry J. Round, Cheltenham; Sidney A. Main, Brighton; James Davidson, Newcastle-on-Tyne. National Scholarships for Mechanics—Aidan N. Henderson, Edinburgh; John E. Jagger, Manchester; William Alexander, Glasgow; Victor G. Alexander, Portsmouth; Ernest A. Forward, London; George E. Parker, Denholme, Bradford; Percy W. Kelsey, Brighton; Frank H. Phillips, Crewe; Joel J. Lee, Portsmouth. Free Studentships for Mechanics—George Walker, Bradford; Marshall H. Straw, Sneinton, Nottingham. National Scholarships for Physics and Chemistry—George M. Norman, Brighton; William S. Tucker, Kidderminster; John Satterly, Ashburton; Robert J. Bartlett, London; Joe Stephenson, Linthwaite, Huddersfield; Lewis L. Fermor, London; Robert Gillespie (junr.), Glasgow; Frederick C. Clarke, Plymouth; Thomas Stenhouse, Rochdale. Free Studentships for Physics and Chemistry—Arthur E. Garland, London; Stanley C. Dunn, London; Harold V. Capsey, Wellington, Salop; Isidore Tom, London. National Scholarships for Biology—Stanhope E. Baynes-Smith, Sheffield; Stafford E. Chandler, London; Arthur Pickles, Burnley; William E. Clarke, London.

THE Scottish Education Department has issued a circular containing a series of proposals for the recognition of a distinct class of higher grade science schools by the Department. For the further encouragement of instruction in science and art in combination with a sound scheme of general education, a grant will be made on the following conditions to the managers of schools which provide a satisfactory course of instruction extending over not less than three years to pupils who have obtained a merit certificate or otherwise satisfy the Department of their capacity to profit by such advanced instruction: (1) The Department must be satisfied that the school possesses a proper equipment for instruction in science and art, namely, sufficient laboratory accommodation, with the necessary apparatus for instruction in science, suitable drawing tables or desks, and an adequate provision of examples for instruction in art, and, as a rule, a workshop or room specially adapted and equipped for instruction in the use of tools. (2) A course of instruction extending over at least three years must be submitted to and approved by the Department, and this course shall make provision for the following:—Experimental science—Not less than four hours a week, of which at least two hours must be spent by each pupil in practical work. Drawing.—At least two hours a week. The course in its earlier stages should embrace instruction in freehand drawing, model drawing from common objects as well as from geometrical models, and drawing to scale of plan elevation and section. Mathematics.—At least four hours a week. (*a*) Geometry and mensuration—practical and theoretical. (*b*) Higher arithmetic and algebra. History and English literature.—The first two years in the latter subject should be devoted to cultivating a taste for good literature by the reading of interesting works of good style and elevation of sentiment. Geography.—A revisal of previous knowledge; the reading of maps (*e.g.* of contour lines) and their construction; elementary exercises in surveying and mapping; a thorough regional survey, by means of excursions, of the physical geography, flora, fauna, and historical antiquities of the district in which the school is situated; a study of commercial geography, based largely upon the shipping and trade news of the daily papers. Manual instruction.—At least three hours. Girls—needlework and dressmaking, cookery. Boys—woodwork, ironwork, clay modelling. In the latter subjects, and in dressmaking for the girls, the pupils will be expected to make a practical application of the drawing taught in the school, and the knowledge acquired in the science lessons can, to some extent, be turned to account for the explanation of the processes in cookery. The Department must be satisfied that the teachers have a competent knowledge of the subjects which they are to teach, and, in the case of science, that they have had experience in treating the subject experimentally. As a rule not more than forty pupils in a class may be instructed by one teacher at one time, nor more than twenty-five in practical work.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 16.—M. Wolf in the chair.—The Perpetual Secretary announced to the Academy the death of M. Pomel, Correspondant in the Mineralogy Section.—On continuous groups of movements in three dimensions of any variety whatever, by M. G. Ricci.—On the differential invariants of a system of $m + 1$ points with respect to projective transformations, by M. E. O. Lovett.—On the representation of varieties of three dimensions, by M. Émile Cotton.—On commutators, by M. P. Janet.—Atmospheric carbon dioxide, by MM. Albert Levy and H. Henriet. After complete removal of carbon dioxide by baryta water, by the prolonged contact of air with caustic potash, fresh quantities of the gas are formed by the slow oxidation of some organic matter existing in the air. Under certain atmospheric conditions, the amount thus formed may amount to nearly as much as the carbonic acid originally present

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